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GUIDELINES FOR ESTABLISHING BEEFPACKING PLANTS IN RURAL AREAS

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On January 24, 1978, four USDA agencies—Agricultural Research Service (ARS), Cooperative State Research Service (CSRS), Extension Service (ES), and the National Agricultural Library (NAL)—merged to become a new organization, the Science and Education Administration (SEA), U.S. Department of Agriculture.

This publication was prepared by the Science and Education Administration's Federal Research staff, which was formerly the Agricultural Research Service.

PREFACE

This publication provides guidelines for determining the feasibility of establishing cattle-slaughter plants in rural areas. It identifies specific prerequisites for a successful cattle-slaughter operation and demonstrates how an industrial survey can be used to determine the potential of a particular livestock-producing area. The approach is primarily one of applied research or interpretive analysis, using basic research published on the subject to make valid decisions about establishing such plants.

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Mention of commercial organizations in this report is solely to provide specific information. It does not constitute endorsement by the U.S. Department of Agriculture over other organizations not mentioned.

Washington, D.C. Issued July 1978

GUIDELINES FOR ESTABLISHING BEEFPACKING PLANTS IN RURAL AREAS

By H. RONALD SMALLEY[1]

The meatpacking industry is rapidly changing. Obsolete slaughter plants in large cities are being shut down as packers shift their operations to rural areas, where livestock is abundant and substantial savings are being realized. Livestock procurement is less complicated and expensive when packers can obtain animals directly from farms and feedlots. Live animals deteriorate in value through shrinkage, bruising, crippling, and death while en route to distant markets. Meat can usually be shipped more economically than live animals. Capital investments in land and facilities tend to be lower in rural areas, as well as labor, taxes, and maintenance costs. Many packers, both those entering the industry and well-established firms, have already participated in decentralizing and updating their facilities. Others are expected to follow.

These changes in the meat industry benefit rural communities in many ways. The local packing plants provide jobs for local labor and help the community to broaden its economic base. They stimulate livestock production in the area. This often encourages feedstuff production. Feed mills prosper and provide local employment. When livestock producers have nearby outlets for their animals, their marketing and transportation costs are reduced and their net returns may be increased.

Many rural communities try to solve problems of chronic unemployment and severe population declines by increasing business development in the area. Communities in livestock-producing areas often consider meatpacking as a potential new industry, since it could enable them to utilize existing resources more fully.

To benefit from the transition taking place in the meat industry, rural communities must be able to attract a beefpacker to their area. But make no mistake about it—beefpackers only locate where they think a profit can be made. Capital requirements are large and profit margins are small in the beefpacking business. Therefore it is essential that investors eliminate as many financial risks as possible before deciding to build. Even the most aggressive firms are not eager to invest in new plants without detailed knowledge of a community's resources and interest in their industry.

The best way to find out whether a community's resources can support a packing plant is to conduct an industrial feasibility survey. The study would identify and analyze factors that affect a packing plant's success. If the findings are favorable, the study provides a sound basis for encouraging plant development. If weaknesses are uncovered in the investigation, a potential business failure can be avoided.

The objectives of this report are to provide guidelines for conducting a feasibility survey for a beefpacking plant and to point out to interested persons the prerequisites for a packing plant to succeed. The report considers only the slaughter of cattle and the processing of beef. However, the same analytical approach can be used to evaluate a community's potential for establishing plants to slaughter other animals such as hogs or lambs.

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PROCEDURES FOR EVALUATING FEASIBILITY

Civic groups, such as chambers of commerce and rural area development committees, often call on government and private organizations to help them decide whether a new packing plant can successfully be established in their area. This is referred to as the "experts' visit approach," in which outside specialists in various fields assist community leaders by providing technical knowledge (*39*).[2]

Such studies can be conducted by one person with broad industry experience, but usually they are handled more effectively by a team of specialists versed in marketing and engineering aspects of the livestock and meat industry. The evaluators should know thoroughly the resource advantages and disadvantages of the area for which the facility is proposed. Assistance is available from the Cooperative Extension Service, State departments of agriculture, State agricultural colleges, as well as from private consulting firms.

It is advisable to precede the study itself with informal discussions between local civic leaders and the outside consultants to determine whether or not the proposal has merit. If the prospects are favorable, then the local leaders should work with the consultants to organize and collect the necessary data. The evaluators must be completely objective in determining the statistical accuracy of all data and be unbiased in appraising local conditions against those necessary for a successful slaughter operation. They must include all relevant factors, both favorable and unfavorable, and maintain a broad perspective of the industry's present and potential trends.

Key environmental and economic factors to consider in comparing local resources with those necessary for profitable packing-plant operations are (1) broad community acceptance of the proposed packing plant; (2) capacity of the plant to avoid air, soil, and water pollution; (3) local availability of slaughter cattle; (4) extent of local packing-industry competition; (5) potential outlets for the proposed plant's beef and animal byproducts production; (6) capital requirements and available financing; and (7) availability of labor and management skills.

These critical factors should be evaluated first. If any of them are decidedly negative, further study will be unnecessary. However, the results may indicate that although current conditions do not justify immediate construction, a local plant may be feasible in the future if certain criteria are met. In that event, the project should be deferred until a more favorable time.

If these basic factors are all favorable, the community's suitability for cattle slaughtering should be further evaluated. Other important factors to consider are the availability of plant sites, local utilities, and sewage-treatment facilities.

In the final steps of the investigation, an analysis of projected income and expenses should be prepared to determine whether the plant could be operated profitably. A preliminary plant layout is necessary to estimate land, facility, and equipment costs. These will be part of the plant's fixed operating expenses. Other costs for livestock procurement, labor and management, insurance, taxes, distribution, and other operating items must also be estimated. Estimates are also needed for the plant's probable sales revenues, based on its anticipated production of beef and animal byproducts.

This projected financial statement will provide an estimate of the plant's probable earnings. If the forecast is favorable, it may be used later as a means of promoting the venture.

Findings that tend to rule out the possibility of success are as important as favorable findings in arriving at an objective evaluation and recommendations. To encourage unfounded hope renders a disservice to the community and may cause waste of rural development funds that could have been channeled to more promising local enterprises. Once established, a packing plant has literally no economical alternative uses. Therefore an accurate feasibility survey is useful whether the final recommendations are positive or negative. Many packing plants established in the past were doomed to failure the moment the decision was made to start because one or more important prerequi-

[2] Italic numbers in parentheses refer to Selected References, p. 71.

sites were either overlooked or not evaluated carefully enough. Some of the most often cited causes of packing-plant failure are (1) an insufficient supply of livestock on a year-round basis, (2) inexperienced management, (3) lack of operating capital, and (4) unsatisfactory sales outlets.

Findings and recommendations should be presented concisely and logically so that valid decisions about establishing and financing the plant can be based on them. If establishment of a beefpacking plant in the community is found to be economically feasible, the contribution of the outside consultants should not be terminated when they present the results of their study. Followup assistance with additional information and technical advice is valuable to help the plant succeed if problems arise in production scheduling, merchandising programs, or other vital segments of the business.

COMMUNITY INTEREST AND ACCEPTANCE

Community approval can substantially enhance the success of any new venture. Lack of it can cause severe problems. Attitudes toward new industry development can often be determined by observing a community's previous economic history. Communities with initiative and a desire to attract industry usually prosper. Those that resist change often become dormant, causing many to seek employment elsewhere.

A proposed industry needs broad support from the entire community, rather than just local endorsement from those who may be associated with the plant's establishment. To accomplish this, all such industrial development projects should be evaluated to assure their compatibility with the community's long-range goals and objectives in solving such problems as unemployment and low income. This might mean that only certain types of new industries should receive support and encouragement. A community might compile lists of those industries it prefers, those that are both harmonious with existing industries and stable from the standpoint that newly created jobs will be of a permanent nature.

Effective communication with all areas and levels in the community is also needed to gain public support. This is particularly true of a slaughter operation, which may generate odors and other nuisances. There must be assurances that, if built, the plant will be located where it will not cause local residents to complain or institute court proceedings that could hinder operations or even force it to close.

To stimulate interest and gain public acceptance for the project, local leaders should point out the advantages of having such a local industry. Immediate community benefits would include an increase in local employment based on the number of people the plant would employ. As a secondary or multiplier effect, additional employment opportunities would be generated in both basic and service-type industries to support the new industry coming into the area.

For example, a new packing plant could stimulate additional cattle and feedstuff production. By locating in a strategic cattle-production area, a local packer's procurement costs would be less, permitting him to bid higher for his cattle requirements. Therefore local producers might realize higher prices for their animals and be encouraged to increase production. In the service sector, a new packing plant would have a direct impact on the economic activities of local feed mills, public cold storage facilities, transportation services, and communication facilities, as well as local merchants, such as gas station operators and retail store owners. These service-type businesses would expand and hire additional employees and in turn would further stimulate demand for local services. Such increased industrial activity contributes to sustained local prosperity and financial stability for the community.

A study measuring the effects of industrialization in Oklahoma (*17*) found that agricultural processing had a higher level of multiplying effect on both production and income than eight other business sectors. And it was second only to manufacturing as the best employment multiplier in generating new jobs. These findings are summarized as follows:

The total dollar increase in business volume generated by a dollar increase in basic production by the business sector in Oklahoma was as follows:

Business sector	*Total increase (multiplier)*
Agricultural processing	$2.50
Livestock production	2.25
Manufacturing	2.15
Services	1.76
Mining, including oil	1.65
Crop production	1.55
Real estate, finance, and insurance	1.54
Transportation, communication, and utilities	1.46
Retail and wholesale trade	1.46

The total dollar increase in total personal incomes generated by a dollar increase in personal incomes by the business sector in Oklahoma was as follows:

Business sector	*Total increase (multiplier)*
Agricultural processing	$4.32
Manufacturing	3.35
Livestock production	2.81
Services	1.58
Mining, including oil	1.57
Real estate, finance, and insurance	1.46
Transportation, communication, and utilities	1.44
Crop production	1.40
Retail and wholesale trade	1.28

The total job increase resulting from the creation of one new job by the business sector in Oklahoma was as follows:

Business sector	*Total job increase (multiplier)*
	Number
Manufacturing	2.93
Agricultural processing	2.82
Mining, including oil	2.56
Real estate, finance, and insurance	1.55
Transportation, communication, and utilities	1.45
Services	1.33
Retail and wholesale trade	1.32
Livestock production	[1]
Crop production	[1]

[1] Employment multipliers were not computed since productivity has been increasing while the number employed has been decreasing. This reflects the rapid increase in technology used in these sectors and the low amount of their interaction with other business sectors.

The multiplier effect, as defined in the study, is the relationship between some observed change in the economy and the amount of economic activity that this change creates throughout the State economy. Interpretation of these multipliers can help measure the impact of new business ventures on local business activity, employment opportunities, and personal incomes. It answers such questions as—What might be the effect on the overall local economy if a new plant were built? What industry tends to create the greatest economic activity per dollar invested for specific rural areas?

Industry representatives frequently are interested in knowing how specific features of the community might affect its desirability as an environment in which to locate and operate. Some questions should be investigated:

Is financing available now and for future needs?

How does the local tax structure affect new business? What concessions or tax relief will be granted to attract a new industry?

How will the State and local ordinances, the industrial zoning and building codes, and the structure of municipal government affect the construction and operation of the plant? Will local officials and voters be willing to support zoning changes, if necessary? Are the police security and fire protection adequate?

Is a desirable site available? Is it sufficiently isolated so that odors, dust, and early morning noises will not become a nuisance to area residents? Are adequate water and sewage-disposal facilities available? Can air, soil, and water pollution be avoided? Are costs of land, utilities, and transportation services reasonable?

What is the makeup of the local labor force, its productivity, need for job-training programs, and prevailing wage rates? Are relations with the local trade unions likely to cause problems?

Has the community planned for any future growth? What is its capacity to absorb population increases? If personnel are brought into the community to live, what amount and kind of housing, education, health services, and general services will be available for these employees?

Many rural communities prepare brochures to furnish such information about their services and resource potentials. Some progressive communities also establish steering committees to assemble additional data that may be requested by firms seeking to locate in their community. Legal services may be donated, once the decision to establish a local plant has been made.

Other communities rely largely on economic incentives to attract new industry. In addition to tax relief, they may offer such financial aid as a free site and a building loan. They may be willing to acquire land, build the facility, and then lease it to the firm, with an option to buy the building later. Such assistance is often very helpful to small businessmen.

Whichever promotional plan or combination of financial inducements is used, the general community must show an active and positive interest if it hopes to encourage new industrial development in its own rural area.

AVAILABILITY OF LOCAL LIVESTOCK

The prime requirement for establishing a rural beefpacking plant is an ample supply of slaughter cattle dependably available on a year-round basis. These animals must be reasonably near and relatively uniform in quality, weight, and finish. To establish a new plant, the local supply of such cattle must exceed the slaughter capacity of the existing local plants.

Before the adequacy of the supply can be evaluated, it is necessary to determine the size of the proposed plant in terms of an hourly kill. This kill capacity is then related to an annual livestock procurement requirement. The size operation to plan on depends on the purposes and the market outlets being considered. Local planners may wish to consult the evaluators about what might be the most efficient and practical slaughter-plant capacity to consider.

In this handbook, small plants are considered to be those with an hourly kill capacity of 1 to 20 head of cattle, medium plants about 60 head, and large plants 120 or more head. Some new facilities have slaughter capacities of 250 head and kills may go as high as 300 per hour in the future. Many packers operate an average of 252 days per year, with 7.2 hours of productivity per workday. These figures allow for weekends, holidays, daily work breaks, and production delays.

The location of the plant should combine an assured supply of cattle at low procurement costs. New packing facilities should be strategically located in areas with high production of cattle for slaughter.

Cattle Procurement Distance

King and Logan (*37*) found that on a dressed-weight-equivalent basis, the cost of shipping 100 pounds of live slaughter cattle was lower than that of shipping the same amount of carcass beef for distances up to 120 miles. However, neither livestock shrinkage nor costs of assembling trucklot loads were included in this analysis of transportation costs. Both factors would tend to reduce the distance over which cattle are cheaper to haul than beef. This and other research (*5, 45*) indicate that the cattle and beef industry can reduce total costs by slaughtering grain-fed cattle near feeding locations and shipping meat rather than live animals to areas that consume more beef than they produce.

Although shipping rate differentials between cattle and beef vary between areas and from one time to another, the above criterion is useful in establishing cattle procurement guidelines for locating new packing-plant sites.

Acquiring full trucklot loads of cattle at one location to qualify for minimum hauling rates normally depends on livestock-assembly concentration points like auctions and terminals, though rural packers purchase most of their livestock directly from producers rather than through such markets. Although many feedlot operators are large enough to ship full trucklot loads, such producers may not always choose to do so because of market conditions or lack of uniform finish among cattle. Therefore to compare both shipping methods fairly, truck routing costs should be considered as an additional expense of shipping livestock where such routing would be needed to form full trucklot loads prior to arrival at packing plants. Likewise, additional expenses due to cattle shrinkage, bruising, and death loss also must be charged to the cost of livestock shipments.

Rural packers prefer to obtain most of their cattle within 50 miles of their plant. Long hauling distances add to the costs of procurement, and dependable schedules for daily slaughtering are more difficult to maintain. Longer hauling distances also increase the amount of animal shrinkage, injury, and death. Buying cattle beyond 120 miles may be uneconomical unless the price in that area is significantly lower. The primary procurement area for a proposed plant site would include the counties that lie mostly within a 50-mile radius of the community. Those counties from 50 to 120 miles away from the site would be the secondary trade area. Cattle procurement potential beyond 120 miles should not be considered as typical in evaluating local slaughter supplies.

However, factors such as continuous plant use at full slaughter capacity, regionally lower processing costs, particularly labor, and efficiencies associated with plant size can tend to obscure the total savings concept of shipping beef rather than cattle.

The evaluators may wish to extend the suggested perimeters for procurement of cattle because of special circumstances in the area or because of the extremely large slaughter capacity of the proposed plant. The larger packers tend to reach out farther for slaughter supplies. Seasonal scarcity of local raw material would also force firms to buy at greater distances than normal. Nevertheless any foreseen need for an unusually extensive trade area would indicate that the community was not an ideal location for a new packing plant.

Estimating Annual Supply of Cattle for Slaughter

To estimate the available livestock, statistics can be developed on the number of beef cattle in each county within a 120-mile radius of the community. Figure 1 illustrates how the possible trade area can be approximated. The community or town requesting the study should be used as a focal point for the proposed site until adequate slaughter cattle supplies are verified and actual sites considered. For counties that overlap the boundaries, all cattle listed in the county should be included to simplify the calculating. Counties that are mostly outside the 120-mile radius should be excluded. Such a trade area would cover more than 45,000 square miles. The primary source of cattle for one successful high-volume packer is generally within a 35-mile radius of each plant, and his total supply comes from an average of about 20,000 square miles of trade area per packing plant.

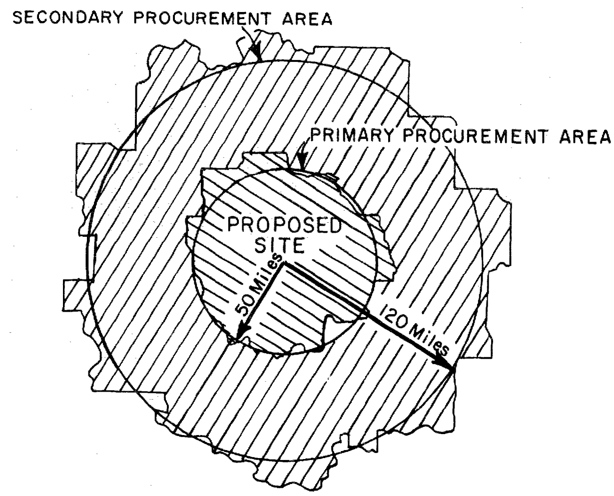


FIGURE 1.—Approximating a trade area for procurement of cattle for a proposed beefpacking plant.

The cattle inventory data should be used for January 1 of the most recent 10-year period available. The January 1 inventories of livestock published by the U.S. Department of Agriculture are computed only by State totals. The prime source of data at the county level is the department of agriculture of the State in which the study is being conducted. If the trade procurement area overlaps into another State, information would be needed from each State department of agriculture. Some States provide comprehensive livestock marketing data by counties, and these figures can be used directly. Unfortunately most States do not compile county marketings, and therefore the inventory data available must be analyzed for an estimate of slaughter supply potential. Some States do not even compile livestock inventory data by counties. Therefore the analysis must be based either on estimates prepared by the State's crop and livestock reporting service or on estimates from questionnaire surveys.

The procedures used to analyze the cattle inventories will depend on the type of livestock programs followed in the area being surveyed. Each of the following situations would require a different method of evaluating the statistics. In situation A, grain-fed cattle would be slaughtered in an area where both feedlot and cow-calf programs are common. In situation B, grain-fed cattle would be slaughtered in an area that supports mainly feedlot operations. In situation C, cull cattle would be slaughtered in an area where most operations are cow-calf programs, or dairying, or both.

Situation A

To support a packing plant in an area that contains both cattle-feeding and cow-calf programs, the counties in the trade area should have a beef-animal population of at least four times the plant's proposed annual kill. The grain-fed cattle marketings from this area will be equivalent to about 25 percent of its current beef-cattle inventory level. This ratio is not constant nor similar for all areas, particularly where nongrain-fed cattle are marketed for slaughter. Estimates must be adjusted for local factors and recent marketing conditions. The local calving rate, the average annual growth rate in local herd numbers, and local practices of cow replacement all affect the ratio of animal inventories to grain-fed cattle marketings in an area.

Cattle and feed prices or unusual weather may cause some producers to change their usual marketing activities. Death loss in herds may deviate from normal. Nationwide it averages 2 percent for all cattle 1 year old and over. Pronounced local fluctuations in both inventories and marketings are possible and should be allowed for in estimating. Farm slaughter of grain-fed cattle should also be considered.

Of course major technological breakthroughs in future reproduction research, such as induced twinning and sex control (*32*), would substantially alter the basic 4-to-1 factor suggested for estimating grain-fed cattle slaughter potential.

Situation B

In areas where feedlot activities are concentrated, most of the feeder stock is brought in from other areas instead of being raised locally. To evaluate the availability of local cattle for slaughter, it is necessary to determine the total inventory capacity of feedlots within the trade area, the average percentage of feedlot capacity that consistently is used during the year, and the average annual turnover of livestock in these feedlots. For example, if local feedlots operate at full capacity throughout the year and the feeding period per animal averages 120 days, the availability of cattle for slaughter could be calculated by multiplying January 1 feedlot inventories by 304 percent less the local feedlot death loss average. This represents an inventory turnover of about three times per year. Continuous feeding activity at full capacity averaging 150 days per head would require a multiplying factor of 243 percent less feedlot death loss (normally about 1 percent or less), or a turnover of about 2.4 times per year. Since there is no assurance that every feedlot will operate at total capacity throughout the year and since feeding periods are not uniform, evaluators must use factors that reflect actual conditions in the area.

Some feedlot operations are used only for backgrounding or "warm-up" programs to prepare young stock under 500 pounds to go on full feed later. Since livestock in these warm-up lots do not go directly to slaughter, they should not be included in the availability analysis. Cattle generally enter commercial feedlots for full feeding at 650 to 750 pounds, although their weights can vary considerably from this range.

Data on inventories for cow-calf programs in the area should be treated as in situation A if producers tend to feed out most of their own stock. However, if most of these locally produced feeders are sold to commercial feedlots, they should not be included, because they will be counted as part of the feedlot inventories.

As more areas turn to feeding local cattle to slaughter weights, competition among feedlots for feeder replacements will become intense. Feedlots where there are no local or nearby cow-calf programs may find that obtaining feeder stock is more and more difficult. To make sure that local marketing of grain-fed cattle will continue to be dependable, the geographic origin of feedlot cattle in the local trade area should be reviewed. The evaluators must appraise whether or not these same feeder cattle supplies will continue to be available to local feedlots. Feedlots that buy most of their feeder replacements from distant States may have higher transportation costs and more transit-related death losses than their competitors. Also, feed-conversion gains are generally very poor for several days after the cattle have been exposed to long-distance hauling.

Situation C

If local cattle operations deal primarily with raising feeder cattle to be fed out elsewhere or with dairying, the cattle available for slaughter would consist chiefly of old breeders and culls. A packing plant proposed for either type of area would be limited largely to producing beef for manufactured meat products. The slaughter of grass- or grain-fed cattle, as well as milk-fed calves, may or may not be considered in combination with such a cull-cattle slaughtering operation.

Widespread use of mechanical tenderizing equipment has significantly increased opportunities for the slaughter of grass-fed cattle in recent years. Such equipment also enables packers to better utilize portions of carcasses from mature animals as well. Likewise, the increased use of mechanical equipment to flake and form beef into portion-controlled cuts has also heightened the uses made of nongrain-fed beef.

To estimate the availability of cull cattle for slaughter, only those animals 2 years of age or over should be considered. Statistics on inventories of total cattle must be broken down to show those under and over 2 years of age. Both beef and dairy cows, as well as all bulls over 2 years old, should be counted.

The usual culling rate or annual replacement for the area must be determined for these cull animals. The average beef cow is held to about 8 years of age, which means a beef cow could be counted as a member of the herd for only 6 years. A herd life of 6 years per cow would require a cull replacement ratio of $16^2/_3$ or about 17 percent a year in order to maintain constant brood cow inventories disregarding death loss (*104*). Extended periods of inventory buildups or reductions in local brood-herd numbers would of course alter this cull-cow availability estimate. Assuming a ratio of 1 bull per 25 cows and a 5–year life cycle with 3 years' herd service, the beef-bull replacement rate would be $1^1/_3$ or about 1 percent a year. Therefore a 17-percent herd replacement rate with heifers, coupled with a 1-percent herd replacement rate for bulls, less an average 2-percent herd death loss would yield about 16 percent for annual slaughter as culls.

Assuming a milk-cow replacement age of 5 years and a 3-year herd life, the dairy cull replacement rate would be 33.3 percent when death loss is disregarded. With widespread use of artificial insemination in dairy herds, dairy bull-calf replacements would average less than the 1 percent estimated for beef-bull replacement requirements.

Actual estimating factors used should reflect local prevailing conditions. For example, beef cows in the area might be replaced on an average of every 7 years. One must remember that such age estimates are averages and therefore include marketings from the early culling of nonfertile cows, for disposing of injured stock, and from periodic upgrading of local herds.

When comparing nationwide statistics of all January 1 cattle and calf inventories (dairy and beef) with annual slaughter, it can be seen that, on the average from 1970 through 1975, for every 100 head on inventory, 30+ cattle were slaughtered each year, with 24+ representing grain- and nongrain-fed cattle marketings and 6+ culls or about 80 and 20 percent, respectively. Thus it should be stressed that these calculating procedures for determining cull-slaughter availability are based on estimates of herd life and not on the estimated life cycle of these animals.

Also, calf slaughter and imports of live cattle and calves slightly affect these nationwide statistical inventory-slaughter comparisons. Calf slaughter per 100 head of cattle and calf inventories averaged 3+ animals annually from 1970 through 1975 but is increasing. This herd extraction factor varies because calf slaughter is inversely related to the demand for feeder calves and cattle. It is particularly evident in areas where packers slaughter dairy calves. When demand for feeder animals is down, calf slaughter goes up and when such demand is up, calf slaughter goes down.

Live cattle and calf imports are insignificant nationally, but they might be of some importance in a survey analysis if the local trade area bordered on either Canada or Mexico.

Evaluating Cattle Supply

After the livestock statistics have been compiled for the appropriate situation, these data should be evaluated. Are there enough cattle available for slaughter in the trade area to meet the proposed plant's needs? Are any trends apparent in inventory and marketing? If any, what is their direction and what is the average percent change each year? Do these local inventories and marketings reflect a pronounced cyclical pattern or part of one during the 10–year period studied? What implications might these combined factors have on future availability of cattle from this local trade area?

Dairying, through cull-cattle and calf slaughter, contributes significantly though in a declining way to total beef and veal supplies. Those evaluating cull-cattle slaughter potential must weigh the nationwide trend in declining dairy animal inventories against existing and potentially offsetting increases in local cow-calf operations of beef animals. Supplemental livestock supplies in the form of grass-fed cattle should be evaluated carefully since their availability to a great extent will vary inversely with the demand for feeder calves and cattle.

A dependable cattle-procurement area should show stable or growing animal inventories without severe cyclical fluctuations. By projecting past livestock inventory trends, a guide may be obtained to forecast future slaughter-cattle availability levels. Do not assume that if a modern packing plant were built, feedlots would automatically appear to supply it. Consider only those feedlots that are in operation or those whose future operation is assured.

The overall analysis for feedlot localities would further depend on the area's comparative advantage in attracting feeder replacements into local lots against rising competition from other feeding areas.

Continued feedlot growth in areas that have abundant local feedstuffs, a good supply of feeder cattle, a favorable climate, and relatively inexpensive land might alter some of the guideline criteria previously mentioned. Total procurement distances in such localities may be reduced to as little as 50 to 60 miles regardless of slaughter-plant capacity. However, the problems of water supply and of pollution caused by solid wastes and feedlot runoff will eventually limit cattle density within any given area. Accumulated cattle wastes from just one 50,000-head feedlot operation are equivalent to those from a city of 600,000 persons (*105*). The offensive odors and dusts from manure concentrations and their tendency to attract and support flies and other vermin build up objections from the community. Therefore any reduction in year-round cattle-procurement distance to less than 50 to 60 miles from a plant does not appear likely for nonintegrated feedlot-packer operators.

Seasonality of Marketings

The supply of local cattle for slaughter must be uniform throughout the year as well as sufficient on an annual basis if a new plant is to operate efficiently at or near its rated kill capacity. Irregular flows of cattle into the plant can create costly gluts on some days and costly shortages on others. Therefore after the trade area's annual cattle-production capacity has been verified as adequate, the seasonal continuity of these slaughter supplies should be investigated. Where monthly marketing data by counties are not available, interviews and questionnaires should be used to evaluate seasonal patterns. Local feedlot operators, livestockmen, commission men, local auction dealers, and others involved in marketing can help determine the typical seasonal flow of these local cattle. Also, where available, statewide data on estimated placements of cattle on feed can be useful. The U.S. Department of Agriculture publishes data listing the numbers of cattle placed on feed by months in 7 States and by quarters in 23 States (*95*).

The more stable a trade area's slaughter supply is throughout the year, the less need there will be to reach out for cattle beyond the trade area to satisfy daily slaughter scheduling.

The total costs of assembling and transporting cattle generally increase in direct proportion to distance, particularly for light shipments that do not qualify for the lowest hauling rates available. Bringing cattle from distant areas to fill daily slaughter quotas during shortages of local cattle can become unprofitable when competition is keen.

In addition to the higher transfer charges, buying cattle from distant points frequently subjects the animals to severe shrinkage, bruising, crippling, sickness, and death. All of these reduce the packer's profit potential. Table 1 shows the shrinkage of fed cattle in transit, as determined in a University of Wyoming study (*73*). This study indicates that time in transit is the principal factor affecting shrinkage of cattle. However, hot temperatures also induce high shrinkage. Each degree rise above the mean temperature during the summer causes fed-cattle shrinkage to rise 0.075 percent. The extent of handling animals in transit also affects shrinkage.

Financial losses from bruises result mainly from crowding, bumping, and rushing the animals, although trampling and horn damage are also factors (*57, 59*).

Since cull cows normally are not marketed evenly through the year, evaluators appraising seasonal marketings for cull-cattle slaughter must be very cautious. Several factors may tend to stabilize local cull-cattle supplies during normally slack periods. Commercial cattle are culled for reasons other than advanced age. The sale of nonfertile cows or injured stock as well as herd upgrading can help even out cull marketings during the year. A firm demand from a local area packer for culls during off-season periods, accompanied by attractive prices and low handling charges, might help persuade producers to cull more evenly through the year. Also, strong consumer demand for processed meats has induced many dairymen in the recent past to hold back their surplus calves to maximize profits by marketing them later at heavier weights as beef animals. Local sales auction data and a survey of producers in the local trade area would provide an estimate of how these factors might operate to eliminate severe seasonal fluctuations and provide reasonably consistent slaughter supplies.

Quality Specifications

Uniform meat quality and cutability of cattle carcasses are other considerations in evaluating local slaughter supplies for table-ready beef. Current consumer preference points strongly toward a demand for lean beef with a well-developed flavor. Consumers look on quality in beef as eating satisfaction with attributes of tenderness, juiciness, and flavor. Most dislike beef with excessive fat and waste, even if all other quality characteristics are favorable.

Meat merchandisers consider still another aspect of beef-animal quality—the cutability or yield of salable beef that a carcass will produce. They want carcasses to be meaty and high yielding as well as high in quality. Their profit potential depends on it.

To satisfy these demands, packers must produce beef tailored to what consumers want and what meat distributors will buy. This means following specification buying practices to obtain uniform lots of young, 1,000- to 1,100-pound grain-fed cattle whose carcasses are meaty and will grade Choice.

To determine how well the local trade area's slaughter supplies can meet these specifications, the evaluators should personally observe and get appraisals from experienced local cattlemen. Such characteristics as breed, weight when entering feedlot, age, and sex all determine the final degree of finish and conformity that will be possible. Desirable beef cattle provide a combination of thickly muscled, high-quality carcasses with rapid growth rate and early maturity. These quality considerations obviously do not apply to cull-cattle supplies used for processed meats, but packers prefer as high a yield as possible from each carcass when it is boned.

Buying Procedures

Another important aspect of slaughter availability includes local cattle sources and buying practices. All procurement methods currently accepted in the trade area should be examined so that the new plant could adopt those practices that would provide stable supplies throughout the year at the best prices possible for both the packer and his local suppliers.

Most rural packers employ cattle buyers to purchase animals from local farms, feedlots,

TABLE 1.—*Shrinkage of fed cattle in transit*

Time in transit (hours)	Sample shipments	Head of fed cattle	Gross shipping weight	Gross receiving weight	Shrinkage
	Number	*Number*	*Lb*	*Lb*	*Percent*
1	7	615	450,300	442,620	1.70
2	24	1,138	1,188,470	1,138,040	4.24
3	42	1,415	1,580,080	1,501,380	4.98
4–6	24	1,001	1,001,070	946,720	5.42
7–9	50	2,132	2,253,750	2,139,640	5.06
10–17	852	29,769	29,938,190	28,079,320	6.20
18–35	97	5,531	4,926,350	4,451,870	9.63
36–59	85	3,610	3,494,590	3,231,440	7.53
60–83	39	2,470	2,423,470	2,214,990	8.60
84 or more	22	1,078	1,119,070	998,040	10.81

and auctions. Many have elaborate communications systems to keep in constant touch with their buyers to coordinate uniform daily cattle flow to their plants. Smaller packers often rely solely on country dealers and commission men to buy their cattle. Some rural packers still use nearby posted public markets, purchasing by private treaty, but to a much less extent than city-oriented operators. Packers also may make contracts with feedlot operators for custom feeding.

To learn whether local cattlemen will support a new plant, the evaluators should interview both producers and livestock-marketing firms within the trade area. It is important to determine the extent of contracts, agreements, or other affiliations that producers already have with other packers as well as how long such commitments have to run. The dispersement of producers and road conditions should also be investigated to see whether any problems might arise in routing trucks and assembling loads.

Customary local selling practices should be determined. Cattle can be sold on a direct liveweight basis, on the basis of dressed-carcass grade, yield, and weight, or on dressed-carcass weight only. Normally sales based on carcass grade, yield, and weight are satisfactory only if no long hauling distances are involved, since excessive shrinkage and bruising of the live animals in long-distance hauling would create many problems. The suggested trade area perimeters, which shorten hauling distance and assembly time, favor the new and more efficient marketing by carcass grade, yield, and weight. Properly implemented, this sales procedure brings producers the most equitable compensation for efficient feeding performance.

Integrated cattle-feeding operations were being used in 1974 by 114 packers throughout the country, representing 6.6 percent of all fed-cattle marketings in 39 States for that year (*93*). Through contract agreements or their own feedlots, they attempt to stabilize the availability of uniform cattle and coordinate it with efficient slaughter scheduling. Many maintain that packer feeding provides a raw-material buffer that will help keep per-unit slaughtering costs down when cattle in their local trade area are scarce.

Although virtually all fed cattle sold are marketed direct through packers or country dealers and through auctions and terminal markets under standardized procedures, other potential marketing methods do exist (*25*) (*35*). A Nebraska study analyzed eight alternative methods of marketing fed cattle, including consignment selling, telephone auction selling, telephone direct selling, and a teletype auction method used in Canada to market hogs (*35*). The teletype method was found to be superior to any of the current marketing methods used in the United States.

Feedstuffs and Feeding Efficiency

In the long run, sustained cattle-feeding activity in the local area depends on the relative profit potential in converting livestock feed into beef. Does the trade area have any advantage in feeding cattle compared with other geographic areas? If it has, its potential for a beefpacking location is strengthened; if not, the area's suitability for such an enterprise is weakened.

Figure 2 shows the relative surplus or deficit of feed grain produced in each State in the continental United States when grain production is compared with the quantity of grain fed to livestock in the same State (*2*). However, to analyze local feedstuff availability, such statistics must be brought down to county and district levels within and adjacent to the trade area studied. Local production data for both grains and roughage should be related to estimates of local consumption by all livestock. State college agronomists can estimate whether current levels of local production can be maintained. The potential of expanded productivity through increasing acreages and per-acre yields should also be considered. Local soil and climate, annual rainfall, reserve water-table supplies for irrigation, and alternative land use would all be factors. Probably the most significant long-run factor for many areas would be the availability of water for irrigated feed-grain production (*54*).

The dependability of local water resources for current and future consumption by cattle should also be appraised. In a feedlot the minimum daily water consumption per head alone is 10 gallons. Other related uses of water in the feedlot can often more than double this minimum consumption requirement per animal (*19, 72*).

Feedlots in areas of deficit grain production are sometimes at a competitive disadvantage, since transportation charges must be added to their grain costs. Where grain production is deficient, hauling costs from the nearest surplus points and the long-run potential of such sources maintaining surpluses for sale must be determined. Such factors can significantly affect the long-run profitability in cattle feeding for areas where production of feed grains is deficient and not likely to increase.

Another important point to evaluate is the local trade area's comparative advantage in feeding cattle. Areas with weather that permits year-round use of the feedlots have a decided advantage over areas where extremes in temperature and humidity cause inefficient feedlot use and poor feed-conversion performance.

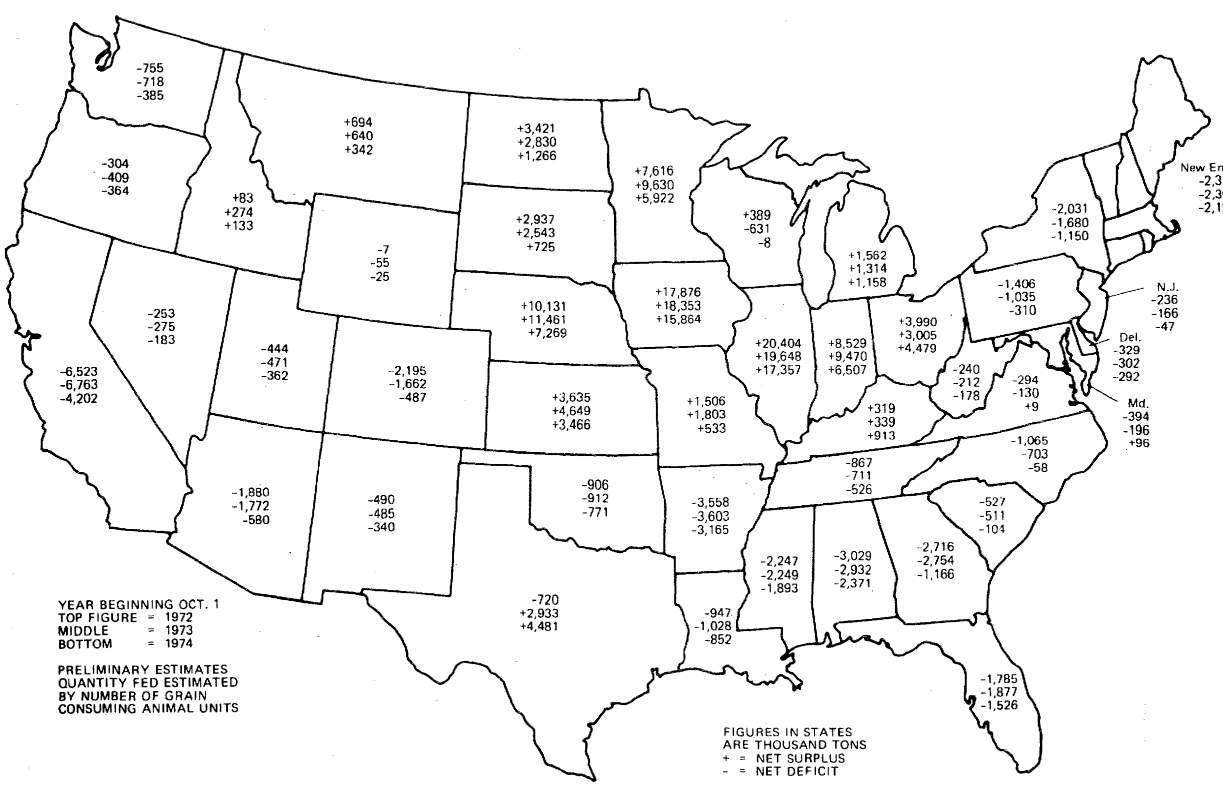


FIGURE 2.—Feed-grain production over or under quantity fed to livestock by States, 1972–74.

Feed-conversion efficiency also depends on the kinds and quality of ingredients in local rations. A well-balanced ration for rapid gain contains about 80 to 85 percent of concentrates and supplement additives and about 15 to 20 percent of roughages. Table 2 gives examples of such rations and the amounts fed per pound of gain in animal weight in Texas and Oklahoma (*16*). Texas feedlots generally placed cattle on feed at lower weights than did feedlots in Oklahoma. This practice made feed-conversion rates in Texas appear slightly better, because the gains included additional growth as well as fattening. Final finishing rations often contain more than 90 percent of concentrates and supplements.

To assess the comparative efficiency of the trade area in cattle feeding, the evaluators should consult State college nutritionists as well as farm and feedlot operators. In the assessment, factors to be considered include prevailing weather conditions; average feedlot size and efficiency; local management skills and practices in cattle feeding; average percentage of feedlot use; breed, weight, age, and sex of feeder cattle entering lots; average length of feeding programs and replacement patterns; nutritional quality of concentrates and roughages fed; extent of use by operators of least cost feed-formulation practices; extent of facilities for steam-flaking grains to increase their nutritional values; and death losses in feedlots.

Overall profitability in cattle feeding depends largely on an area's capacity to raise or obtain feedstuffs at reasonable prices and its feed-conversion efficiency. This assumes that an adequate supply of feeder cattle is available at competitive prices. Basic determinants for cattle-feeding profits, including demand factors for fed cattle and dressed-carcass beef, are discussed by King and Schrader (*38*). Ideally the optimum packing-plant location for fed-cattle slaughter would occur in those areas capable of efficiently carrying out both feed-grain production and cattle-feeding programs simultaneously.

For areas concentrating in dairying or cow-calf operations, local forage availability would be of primary concern. Grains and supplements fed are often shipped into such areas. Consequently, a packing-plant location for cull-cattle slaughter does not depend on local availability of grain nor on feed-conversion efficiency. Local dairymen and livestockmen depend on fluid milk or feeder cattle as their principal source of income; cull marketings represent supplemental income.

The evaluators should appraise production of local roughages and grazing conditions to determine whether the trade area can maintain current dairy and brood-herd inventories and

TABLE 2.—*Average volume of feedstuff fed per pound of animal gain in Texas and Oklahoma feedlots*

Feedstuff	Texas		Oklahoma	
	Lb	*Percent*	*Lb*	*Percent*
Concentrates:				
Grain sorghum	5.50	65.4	5.75	63.5
Barley and corn	.12	1.4	.61	6.7
Premixed supplements	.48	5.7	.55	6.1
Molasses	.28	3.3	.37	4.1
Fat	.15	1.8	.05	.6
Other concentrates	.16	1.9	.09	1.0
Total	6.69	79.5	7.42	82.0
Roughages:				
Silage	.39	4.7	.74	8.2
Cottonseed hulls	.54	6.4	.25	2.7
Other roughages	.79	9.4	.64	7.1
Total	1.72	20.5	1.63	18.0
Grand total	8.41	100.0	9.05	100.0

whether local roughage productivity and grazing can be expanded. Climatic conditions are important. Areas in the Southeast, with green pastures most of the year, can maintain cow-calf operations with about 2 to 4 acres of grazing land per animal unit. Ranches in the West may have stocking rates varying from 6 to 8 or up to 100 acres or more per animal unit.

Generally about 12 to 15 pounds of cured roughage or an equivalent amount of dry matter from grazing material is required to produce 1 pound of animal gain. Average amounts of feedstuffs needed to maintain dairy and brood cows can be obtained from each State, as well as grain and roughage consumed per animal on feed by State (*2*).

During periods of short feed-grain supplies and resulting high feedlot expenses, nongrain-fed beef production rises, with pasture, hay, and crop residues being the primary source of nutrients. In the long run, however, grains are and will remain an important part of the beef-cattle ration because gains are obtained more rapidly and more beef can be produced from an acre of grain than from an acre of forage. Attempting to forecast the extent and dependability of grass-fed cattle supplies, therefore, will remain difficult since the type of beef produced and the feed rations used to produce it will be determined by economics. When grain prices are high relative to other feed sources, then less grain will be used for beef production and when grain prices are low, the reverse will occur (*52a*).

EXTENT OF LOCAL COMPETITION

After establishing the fact that local slaughter-cattle marketings exceed the proposed plant's anticipated requirements, the next step is to determine whether these cattle will be available, considering the current extent of local slaughter-plant capacity. The data collected for this analysis can be obtained at the same time as those for the availability of local cattle. A comparison between local marketings and existing slaughter capacity will indicate whether there is any surplus of cattle and the probability of getting enough of this surplus to operate the size plant being considered. Rural sites most attractive to packers are those where the ratio of dependable slaughter-cattle marketings far exceeds the aggregate kill capacity of local slaughter plants.

One effective method of estimating the full extent of local packing-plant competition is to survey trade area feedlot operators and others to determine what proportion of their cattle marketings is being shipped outside the trade area to be slaughtered. During 1975 almost 70 percent of all cattle sold to packers went direct (*93*). Therefore a survey of these local cattlemen could be assumed also to provide estimates concerning specific plant procurements for both local and distant competing packers. Another method of estimating competition and existing plant capacity is by interviewing local businessmen who are familiar with packing-plant operations in their area. Actual slaughter-production data from individual packers are acquired by Federal and State departments of agriculture but on a strictly confidential basis. Such information is used solely for developing composite production statistics (*96*).

Estimates of local slaughter activity would include the number, location, and hourly kill capacity of each packing-plant competitor within and adjacent to the proposed plant's trade area. Local plants that kill other animal species and those that do not compete for the same type of cattle would be excluded. For example, a proposed plant for cull-cattle slaughter would consider only those firms specializing in commercial grade cattle. A plant to slaughter grain-fed cattle would consider only fed-cattle killing operations. Where both grain-fed cattle and culls are slaughtered in the same plant, only that proportion of plant capacity that competes directly should be considered.

If some portion of the slaughter-plant capacity is continuously being used to kill grass-fed cattle, then this should be considered when appraising the extent of local slaughter-plant capacity and competition.

The age and physical condition of competitor facilities should be considered. The level of technology used in each plant and the efficiency of their operations will also influence their effectiveness to compete.

The annual level of plant use of these competing plants, including overtime and second shifts, should be estimated, along with their potential for handling added volume by increasing their hourly kill rate. Most existing slaughter-plant coolers hold the production of 3 days' kill, based on workdays of only one shift. Newer plants with a one-shift operation commonly are designed with 2 days' holding capacity. Those with cooler capacities substantially larger than these amounts have the potential for sustained overtime operations or possibly a second shift, depending on the amount of extra cooler space and whether the firm performs other processing functions, such as carcass breaking and boxing. Productive slaughter activity of 7.2 hours per day at plant capacity is considered 100-percent use of slaughtering facilities, but some plants can and do operate at higher production levels.

Particular attention should be given to any firm or firms currently operating far below plant capacity. Does this condition represent a temporary or a long-term problem? Are there any other significant factors causing the problem besides a lack of cattle supplies? If so, what are they?

If any local beefpacking plants are either closed or operating under receivership, the reasons and circumstances behind such events should be determined.

For a visual appraisal of competition in the proposed plant's primary and secondary trade areas, local beefpacking plants currently in operation can be pinpointed on a map. Those that do not compete for the same type of cattle as the proposed plant need not be considered. Draw concentric circles with 50- and 120-mile radii around each existing beefpacking plant, as shown in figure 3. Next, illustrate cattle density at the county level by using dots, where each dot represents a given number of current January 1 inventories. This helps visualize where cattle concentrations are prevalent. Then complete the form below figure 3. Naturally such boundaries do not limit buying activities of slaughter plants, but they can show where a packer might expect to have an advantage over another in cattle procurement. If cattle density is relatively uniform among counties, a packer could logically expect to have lower assembly and transportation costs in a primary procurement area where most competition comes from distant packers.

Regardless of whether the seller pays for transportation or whether the packer does, both can increase their profit potential by reducing hauling distance and the time that slaughter cattle spend in transit. If the seller pays, he knows that he can accept a similar bid on his cattle from a nearby packer over a distant rival and come out financially ahead. If the packer pays, he knows his actual shrink factor as well as his hauling costs will be less and therefore he is in a position to bid higher for his procurements and still acquire them at lower cost than competitors hauling cattle hundreds of miles. In a U.S. Department of Agriculture study, Gustafson and Van Arsdall reported that the seller pays for transportation on about 90 percent of the fed cattle marketed (*27*). Small feedlot operators pay transportation on almost all their fed cattle, whereas large feedlot operators occasionally sell their fed cattle without incurring such transportation costs.

After a thorough evaluation of slaughter plants already operating in the area, the evaluators can then judge the actual potential for the proposed new plant. The analysis may reveal that there are indeed sufficient surplus slaughter cattle available to satisfy the plant's projected kill capacity. On the other hand, the investigation might indicate that the supply is such that the proposed kill capacity could be increased or that it would be wise to scale it down below that originally proposed. Or perhaps it may even become evident that one more local plant might create excessive competition, causing existing packers to operate below their normal kill capacities.

Excessive levels of competition can often become counterproductive to a rural area's goals of increased job opportunities and stable growth. Coupled with this argument is the fact that meatpacking unfortunately is a low-profit business. It normally survives on volume operations. Table 3 shows that industry earnings after taxes averaged less than 1 percent from 1963 through 1975 (*3*). This compels plant managers to operate as near as possible to their

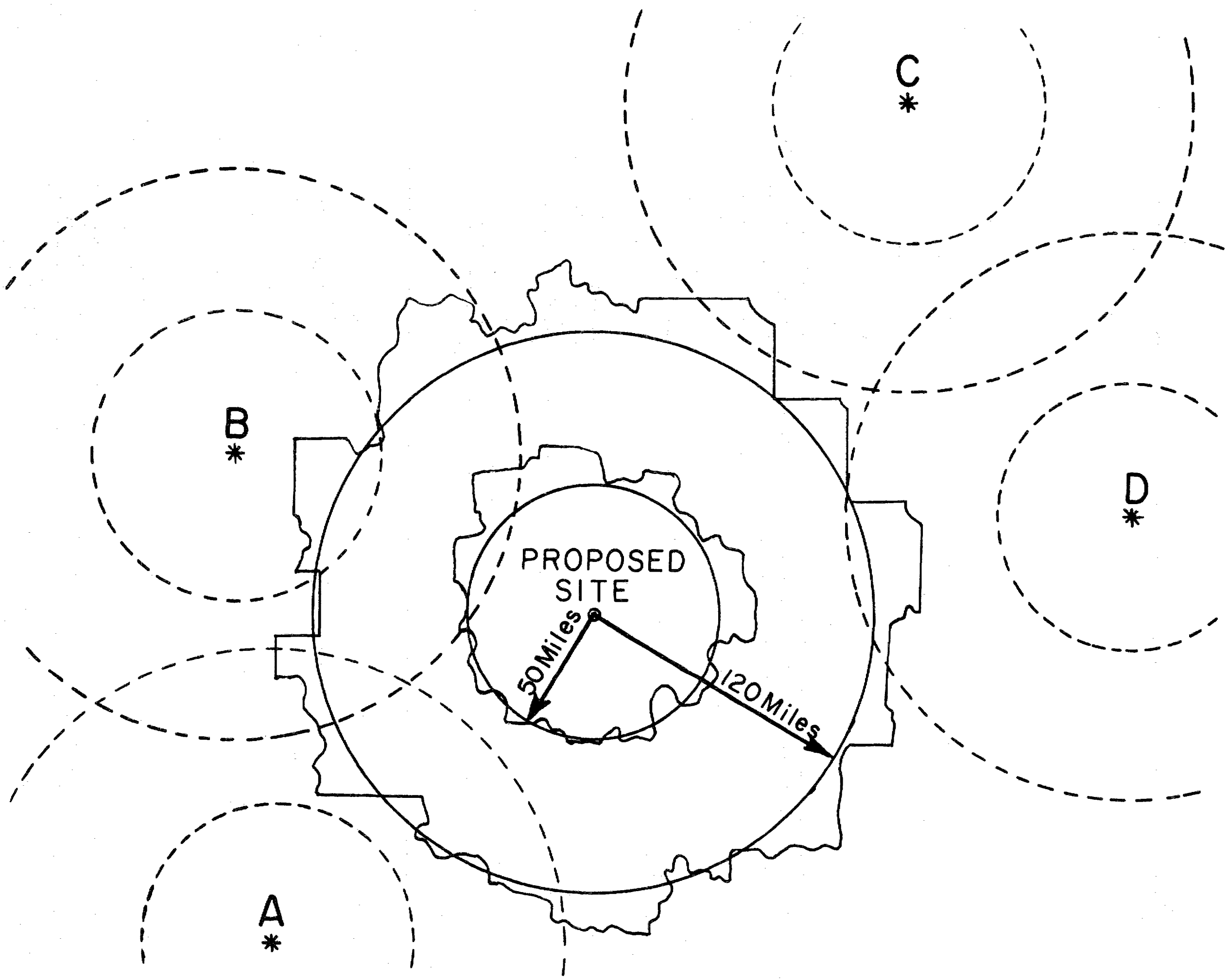


FIGURE 3.—Method of showing competitive cattle-procurement conditions facing a proposed beefpacking plant. (Asterisks indicate existing plants.)

Local plants	*Distant plants*	*Slaughter capacity*	*Estimated annual level of plant use*	*Estimated annual cattle slaughter*	*Estimated annual cattle procurement from proposed plant's trade area*	
		Kill per hour	*Percent*	*Number*	*Number*	*Percent of kill*
A	------					
B	------					
C	------					
D	------					
------	E					
------	F					
------	G					
Total or average -------------						

maximum capacity to reduce slaughtering costs per unit of production.

Therefore community leaders in areas that already contain ample to excessive slaughter capacity should seriously consider other courses of action before attempting to promote a new packing plant. Suppose, for example, the evaluators find that, though there are too many local packing plants, some are old, outmoded, and highly inefficient. Under these circumstances, local employment opportunities in this industry might be improved through consolidating and improving old plants rather than by introducing additional competition. A high level of steady employment might be achieved by promoting the merger of some local firms, either by remodeling and modernizing one of the older plants or by constructing an entirely new one, and combining their volumes. This could mean that employees might have to commute to a nearby town instead of working locally if the evaluators find that another community is a more suitable plant location than their own.

Nevertheless in the interests of better rural development, communities should avoid rivalry over plant sites. Cooperation among communities is the key to providing maximum rural employment and avoiding wasteful duplication of investment capital. Vital development funds may then be channeled into other enterprises and thereby further local employment potential rather than diminishing it through excessive competition.

In the past, rural-oriented packers could simply reach out farther into producing areas for raw material whenever cattle marketings were poor in their immediate trade area. This practice, however, is becoming increasingly difficult because of the intense competition generated through the trend of packers moving to rural areas. Plants that depend too much on distant procurements are finding their normal flow of cattle intercepted by competitors more strategically located.

New plants should be located where packers will be able to acquire two-thirds to three-quarters of their raw materials within the proposed plant's primary trade territory and the remaining volume within the boundaries of the secondary area. The plant should operate at 95 to 100 percent of its hourly rated kill capacity throughout the year.

Sparse cattle density in some areas, excessive competition in others, as well as poor initial planning can contribute to unsatisfactory rural plant location with excessive slaughter capacity and high procurement costs. A University of California study (*43*) in a sample survey reported that western rural packers obtained only 34 percent of their cattle from primary trade areas within a 50-mile radius of their plants, almost 25 percent from 50 to 100 miles away, about 29 percent from 100 to 200 miles, and the remaining 12 percent at over 200 miles.

Figures 4–6 show the locations of packing plants operating in the continental United States, Alaska, and Hawaii (*92*). They include plants that slaughter all types of livestock except horses. Several are multispecies-slaughter establishments, which kill more than one type of livestock in the same facility.

Since the end of World War II, livestock producers have tended to specialize by area, and this has been chiefly responsible for another change in the meatpacking industry. New and remodeled plants in rural areas usually slaughter only one animal species. The older metropolitan-oriented plants had ready access to all species from nearby terminal stockyard markets, but these multispecies-slaughter plants are rapidly disappearing as terminal market receipts continue to weaken.

Approximately 92 percent of all animals slaughtered commercially in the United States, excluding horses, are processed in Federal-approved packing plants. The remaining 8 percent are attributed to State-approved slaughter plants.

On March 1, 1975, 1,239 plants were under Federal inspection and 60 plants were inspected under the Talmadge-Aiken program (fig. 4). In 40 States, 2,571 plants were under State inspection (fig. 5). These figures represent packing plants that either slaughtered livestock only or had combination operations that included slaughtering and some form of further meat processing. All meat plants involved solely in processing red meats as well as those involved in poultry slaughtering and processing were excluded from the State totals shown in figures 4 and 5.

TABLE 3.—*Sales, raw-material costs, operating expenses,*

Item	1963 Amount	1963 Proportion	1964 Amount	1964 Proportion	1965 Amount	1965 Proportion	1966 Amount	1966 Proportion	1967 Amount	1967 Proportion
	Million dollars	*Percent*	*Million dollars*	*Percent*	*Million dollars*	*Percent*	*Million dollars*	*Percent*	*Million dollars*	*Percent*
Total sales	15,325	100.0	15,900	100.0	17,125	100.0	19,500	100.0	19,825	100.0
Cost of livestock and other raw materials	11,345	74.0	11,735	73.8	13,015	76.0	15,220	78.0	15,115	76.2
Gross margin	3,980	26.0	4,165	26.2	4,110	24.0	4,280	22.0	4,710	23.8
Operating expenses:										
Wages and salaries	1,750	11.4	1,785	11.2	1,775	10.4	1,850	9.5	1,960	9.9
Employee benefits:										
Retirement expenses	43	.3	44	.3	50	.3	61	.3	63	.3
Social Security taxes	69	.4	68	.4	68	.4	84	.4	89	.5
Insurance and hospitalization	59	.4	64	.4	67	.4	70	.4	78	.4
Vacations, holidays, and sick leave	116	.8	117	.7	114	.7	119	.6	128	.6
All other benefits[1]	----	----	----	----	----	----	----	----	----	----
Total employee benefits	287	1.9	293	1.8	299	1.8	334	1.7	358	1.8
Interest	33	.2	34	.2	34	.2	47	.2	54	.3
Depreciation	125	.8	124	.8	138	.8	145	.8	154	.8
Rents	50	.3	54	.3	57	.3	62	.3	65	.3
Taxes[2]	46	.3	43	.3	44	.3	52	.3	51	.2
Supplies and containers	565	3.7	575	3.6	565	3.3	590	3.0	650	3.3
All other expenses	880	5.8	925	5.8	950	5.5	965	5.0	1,070	5.4
Total operating expenses	3,736	24.4	3,833	24.0	3,862	22.6	4,045	20.8	4,362	22.0
Earnings before taxes	244	1.6	332	2.2	248	1.4	235	1.2	348	1.8
Income taxes	115	.7	150	1.0	106	.6	101	.5	148	.8
Net earnings	129	.9	182	1.2	142	.8	134	.7	200	1.0

[1] Not reported separately until 1969.
[2] Other than social security and income taxes.

Figure 6 includes only State inspection-exempt slaughter plants, which are defined as those approved for the custom slaughter of livestock and game for the exclusive use of the owner, members of his household, and nonpaying guests. As of March 1, 1975, 1,514 plants were in this category. Data concerning Federal inspection-exempt slaughter plants in the remaining States were unavailable, since only a composite total for the following four categories was compiled: (1) Livestock and game slaughtering only, (2) livestock and game slaughtering with red meat processing, (3) red meat processing only, and (4) poultry slaughtering and processing.

SALES AND DISTRIBUTION

Meat Consumption Trends

To establish realistic long-range production goals as well as profit objectives, beefpackers must appraise future trends in the demand for beef and competing protein products. Such trends are of vital concern whether planning *and net earnings of U.S. meatpacking industry, 1963–75*

1968		1969		1970		1971		1972		1973		1974		1975	
Amount	Proportion	Amount	Proportion	Amount	Proportion	Amount	Proportion	Amount	Proportion	Amount	Proportion	Amount	Proportion	Amount	Proportion
Million dollars	*Percent*	*Million dollars*	*Percent*	*Million dollars*	*Percent*	*Million dollars*	*Percent*	*Million dollars*	*Percent*	*Million dollars*	*Percent*	*Million dollars*	*Percent*	*Million dollars*	*Percent*
20,750	100.0	23,125	100.0	24,400	100.0	24,725	100.0	27,800	100.0	33,225	100.0	35,500	100.0	36,775	100.0
15,870	76.5	17,830	77.1	18,840	77.2	18,775	75.9	22,025	79.2	26,935	81.1	28,260	79.6	29,025	78.9
4,880	23.5	5,295	22.9	5,560	22.8	5,950	24.1	5,775	20.8	6,290	18.9	7,240	20.4	7,750	21.1
2,055	9.9	2,215	9.6	2,310	9.5	2,360	9.5	2,345	8.4	2,540	7.6	2,725	7.7	2,885	7.8
83	.4	86	.4	99	.4	105	.4	97	.4	111	.3	130	.4	147	.4
92	.4	102	.4	105	.4	107	.4	117	.4	151	.5	172	.5	182	.5
83	.4	92	.4	99	.4	105	.4	111	.4	136	.4	155	.4	179	.5
140	.7	140	.6	146	.6	147	.6	156	.6	168	.5	184	.5	203	.6
----	----	29	.1	31	.1	33	.1	36	.1	40	.1	43	.1	46	.1
398	1.9	449	1.9	480	1.9	497	1.9	517	1.9	606	1.8	684	1.9	757	2.1
55	.2	70	.3	81	.3	75	.3	82	.3	105	.3	141	.4	134	.4
160	.8	170	.7	181	.7	191	.8	200	.7	200	.6	214	.6	236	.6
65	.3	69	.3	73	.3	75	.3	90	.3	86	.3	95	.3	102	.3
62	.3	59	.3	59	.3	61	.3	61	.2	65	.2	74	.2	78	.2
660	3.2	745	3.2	775	3.2	785	3.2	795	2.9	845	2.6	995	2.8	1,165	3.2
1,080	5.2	1,125	4.9	1,135	4.7	1,295	5.3	1,265	4.6	1,240	3.7	1,645	4.6	1,725	4.7
4,535	21.8	4,902	21.2	5,094	20.9	5,339	21.6	5,355	19.3	5,687	17.1	6,573	18.5	7,082	19.3
345	1.7	393	1.7	466	1.9	611	2.5	420	1.5	603	1.8	667	1.9	668	1.8
160	.8	188	.8	222	.9	277	1.1	185	.7	263	.8	292	.8	294	.8
185	.9	205	.9	244	1.0	334	1.4	235	.8	340	1.0	375	1.1	374	1.0

new slaughter plants or remodeling and expanding existing facilities.

Since the 1950's the demand for beef in the United States has had an unprecedented growth. Red meat consumption per person increased over a fourth, with all the increase attributed to beef. As shown in table 4, beef accounted for 44 percent of the total red meat consumed in 1950 (*1, 14, 64, 94*). By 1960, beef's share of the total had risen to 53 percent, and by 1970 it was 61 percent. Three reasons for this strong demand for beef have been growth in disposable income, fairly stable beef prices, and consumer preference. If future interrelationships among disposable income, beef prices, and prices of other protein foods do not make beef substantially more expensive, beef consumption per person is expected to rise to about 126 pounds and account for 64 percent of all red meat consumed by 1980 (*66a*).

In 1975 about 214 million Americans lived in the United States or served in the Armed Forces abroad. Projected population estimates (*98*) indicate that there will be 223 million by 1980, a gain of 9 million in 5 years. If both population growth and increased per capita consumption continue, total domestic beef requirements will be about 28.2 billion pounds by 1980. This represents an increase of almost 10

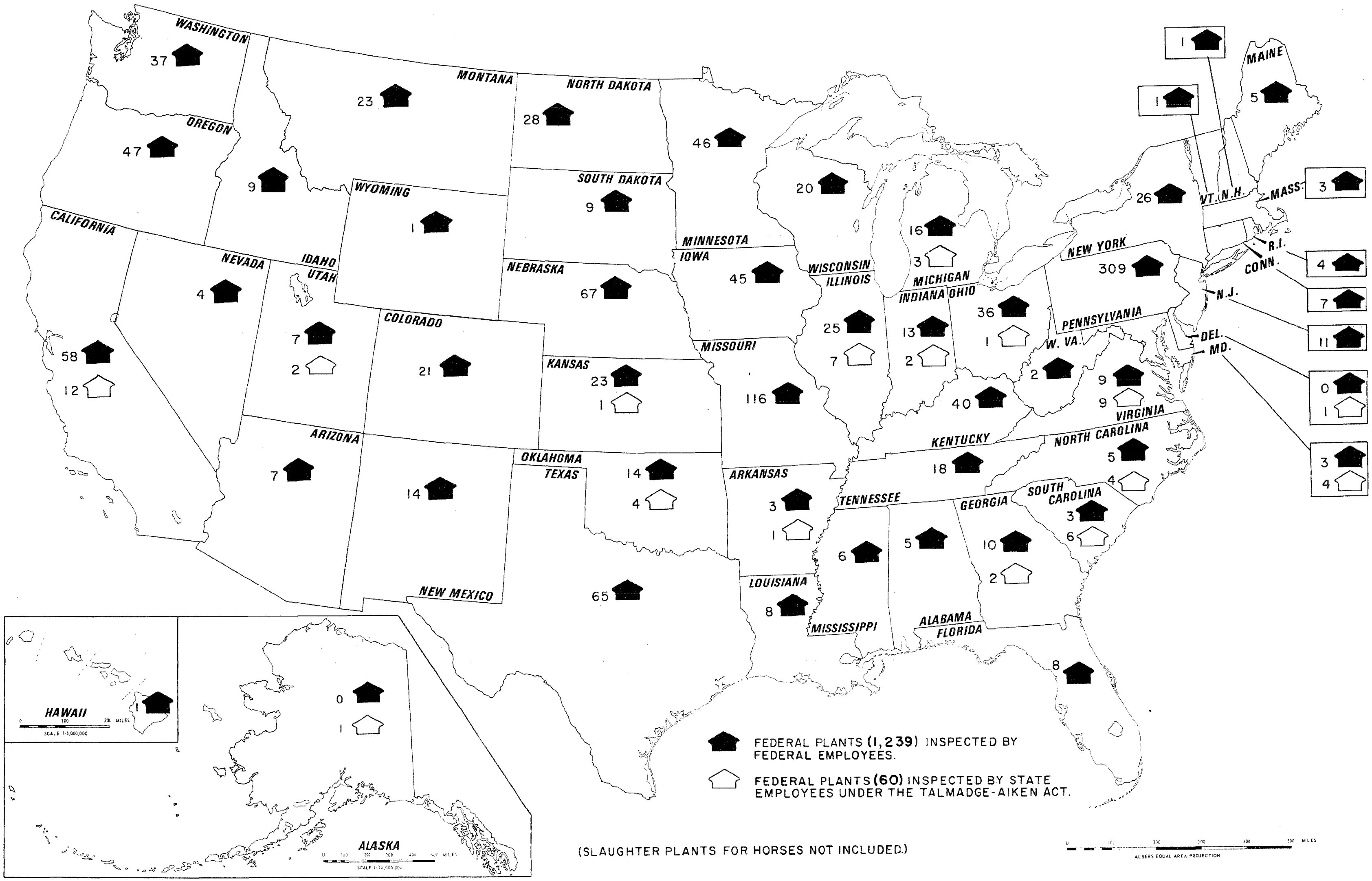


FIGURE 4.—Location of all Federal-approved livestock-slaughter plants in the United States, 1975.

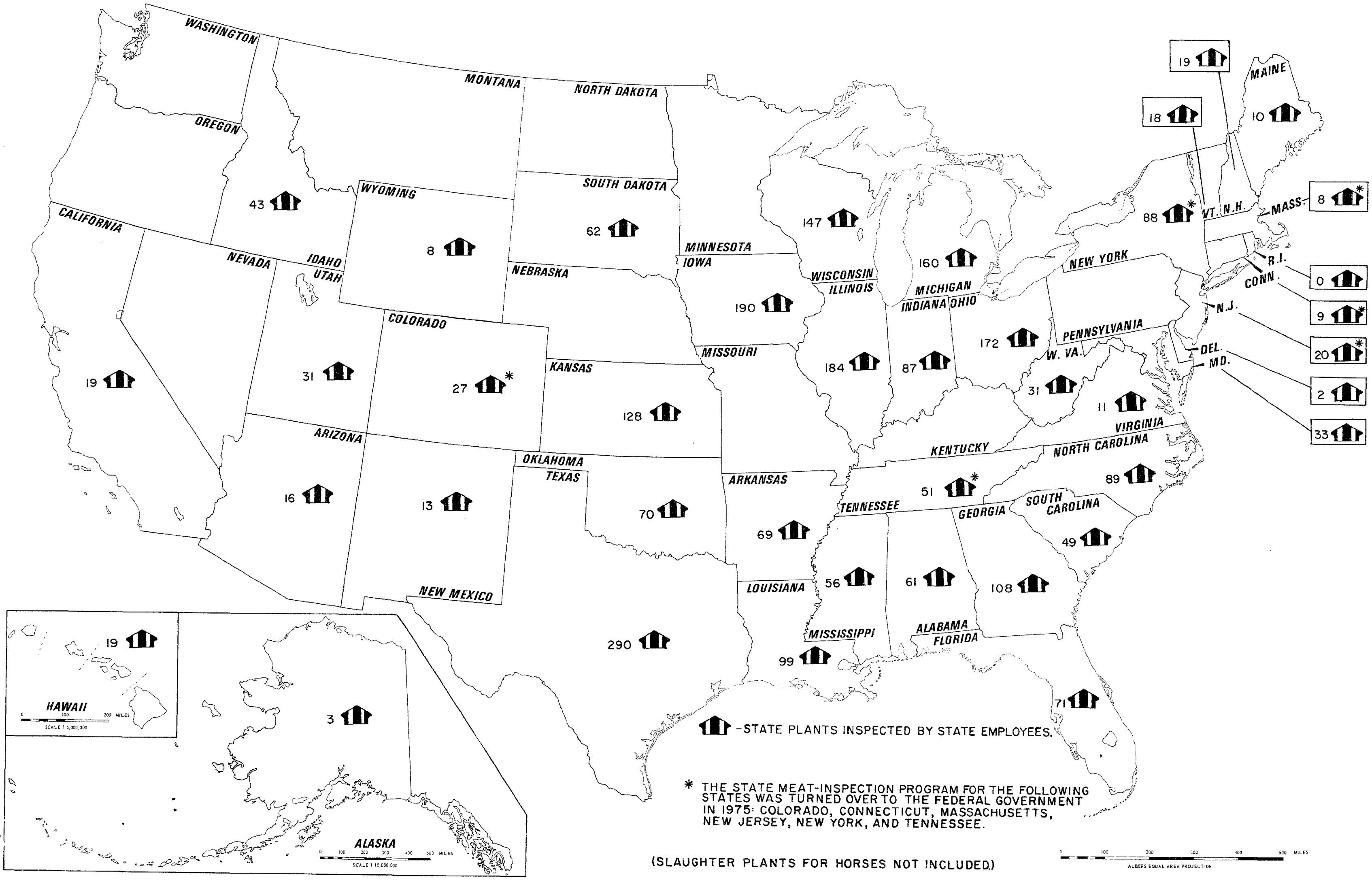


FIGURE 5.—Location of all State-approved livestock-slaughter plants in the United States, 1975.

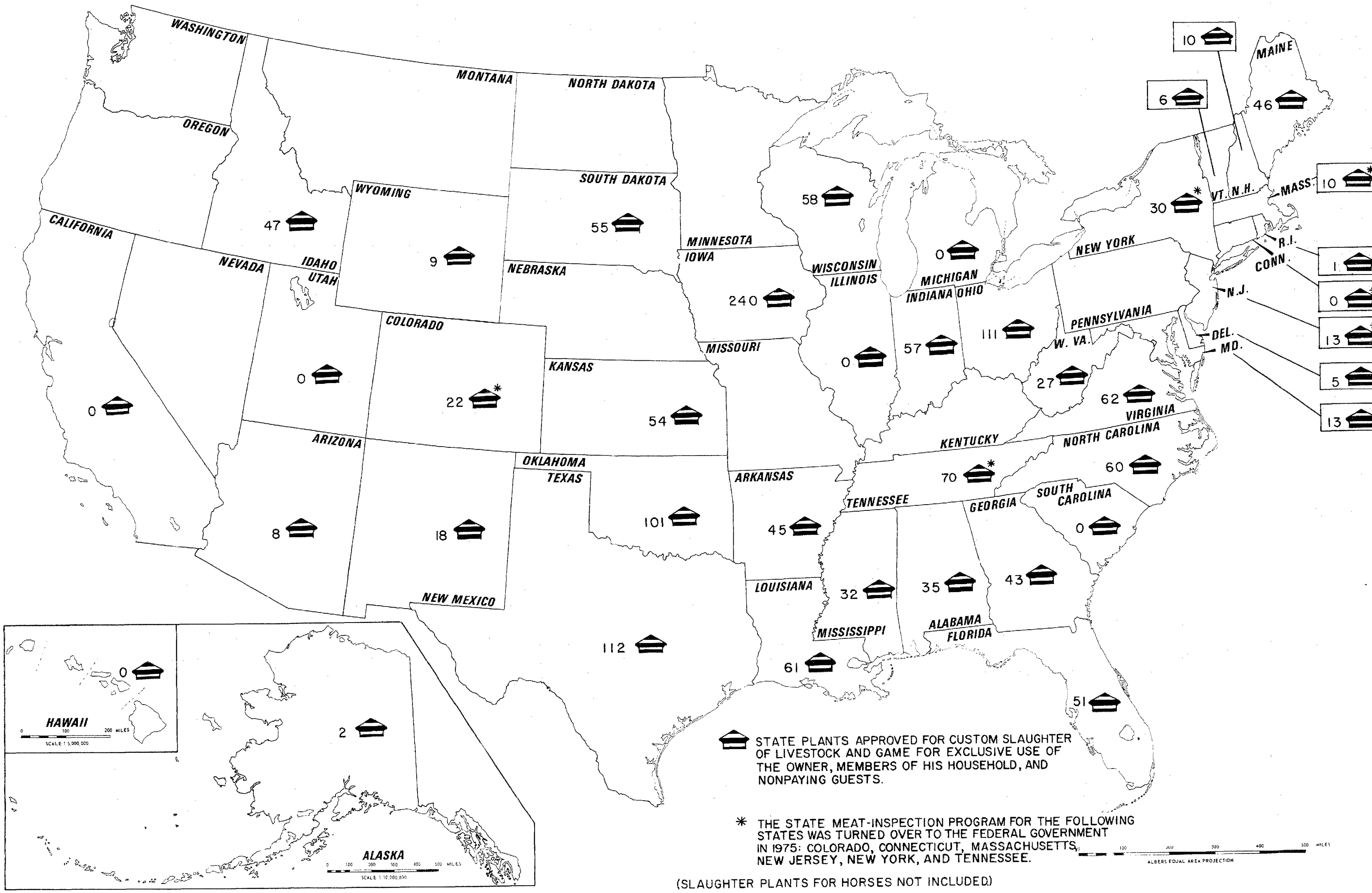


FIGURE 6.—Location of State inspection-exempt plants approved for custom slaughter of livestock and game in the United States, 1975.

TABLE 4.—*Consumption of selected protein products for selected years, with projected estimates for 1980*

Protein products	Consumption per person				
	1950	1960	1970	1975	1980
	Lb	*Lb*	*Lb*	*Lb*	*Lb*
Beef	63.4	85.1	113.7	120.1	126.3
Veal	8.0	6.1	2.9	4.2	1.5
Pork	69.2	64.9	66.4	54.8	68.1
Lamb and mutton	4.0	4.8	3.3	2.0	2.4
Red meat[1]	144.6	160.9	186.3	181.1	198.3
Poultry[2]	24.7	34.1	49.7	48.9	59.0
Fish[3]	11.8	10.3	11.8	12.1	13.7

[1] Carcass weight.
[2] Ready-to-cook weight of chicken and turkey; minimal consumption levels of duck and geese are excluded.
[3] Edible weight.

percent or about 2.5 billion pounds over 1975 consumption levels of 25.7 billion pounds.

However, future anticipated increases in worldwide demand for beef may have some repercussions on future domestic beef consumption and the need for expanded slaughter-plant production. World beef and veal consumption per person increased significantly in most countries between 1961 and 1971 (*91*), particularly among the industrialized nations. Consumption increased in beef exporting nations like Australia, New Zealand, and Ireland, as well as net importing communities, such as the eight remaining European Common Market Countries, and Canada, Austria, Switzerland, Spain, and Portugal. During this 10-year period, per capita beef consumption in Japan, Israel, and Greece more than doubled. Although Japan is still the lowest per capita beef consumer of all the developed countries, averaging only 7 pounds per person, that nation's increasing desire for beef could become a significant factor in world markets, considering its accelerating growth in disposable income and a population of 111 million. Japanese beef imports could surge appreciably higher if quota restrictions were removed. With prosperity, beef consumption per person in Europe could move much higher as well as that in Canada and other nations as their standards of living rise. Thus, other industrialized nations could bid away a portion of the beef supplies normally imported into the United States as well as some premium cuts coming from domestic supplies here.

If supplemental beef supplies from imports fail to keep pace with projected domestic demand, and significant amounts of domestic beef are exported, both U.S. cattle production and beef-slaughter capacity might have to be expanded further. In 1975, beef imports amounted to almost 1.8 billion pounds (carcass-weight equivalent) or 7 percent of total U.S. consumption that year (*89*). Most of these imports are boneless fresh and frozen beef used in manufactured meat products. Beef exports, on the other hand, were negligible in 1975, amounting to less than 54 million pounds.

However, unless some major technological advance, such as twinning, enables American cattle producers to substantially increase beef production at fairly stable prices, future increased world demand for beef may have a substitution effect on projected increases in domestic beef demand rather than a supplemental one. In other words, if some traditional beef imports are diverted to other nations and exports of American beef eventually become a factor, any possible future increases in sales opportunities for U.S. beef abroad would probably be at the expense of projected increases in domestic beef sales rather than in addition to them, since foreign markets would likely bid up prices beyond levels that some Americans would be willing to pay for beef and thereby curtail domestic demand.

According to projected estimates (*14, 66a*) for 1980, domestic per capita consumption of veal will probably decline slightly, whereas consumption of lamb and fish will rise beyond current levels. Consumption per person of chicken and turkey as well as pork is expected to rise markedly by 1980 but at the expense of other foods rather than beef as Americans continue to change their dietary habits by eating increasingly greater amounts of protein foodstuffs. Total pounds of all food consumed per person will remain fairly stable.

Any future threat to the demand for beef from the substitution of vegetable proteins may have no effect on domestic beef production but instead may become a substitute to some extent for beef imports now used in processed meats manufactured domestically. At present levels of protein-isolate technology, imitation meats, flavored and textured to simulate natural meats, are expensive and have limited consumer appeal. But other cheaper forms of vegetable proteins, such as soy grits, can be and already are being used in the industry as extenders. Moreover, scientists are working on semimeat products made by blending vegetable proteins with real beef, somewhat like margarine is made by blending vegetable oils with milk solids and animal fats.

For those seeking a longer term look at prospects for the beef industry, forecasters have estimated that beef and veal consumption per person will climb to 130.4 pounds by 1985, with a range from this baseline estimate being a low of 125.3 pounds to a high of 133.5 pounds (*66a*). Coupled with a projected 1985 population estimate of 234 million (*98*), this means that beef and veal sales should be somewhere between 29.3 and 31.2 billion pounds by then. The higher consumption estimate for 1985 is premised on demand continuing to be stimulated through rising disposable incomes of consumers and realistic future beef prices relative to other protein foods.

The consumer boycott and subsequent price freeze on beef during 1973 clearly illustrate that although Americans enjoy eating beef and prefer it to other protein foods, there is a limit to how much of their disposable income they are willing to use to pay for it.

Potential Market Outlets

The approach used to analyze the market potential for the proposed plant's beef production will depend on whether the plant is to be built by an established packer or by newcomers to the industry.

A national, regional, or even sectional packer will already have established channels for marketing meat products. The output of the new plant would have to be fitted into the firm's overall marketing program. The packer involved would participate in the marketing analysis from the outset to help establish the size of slaughter operation that would best meet its increased needs for beef.

If, however, no specific packer is being considered at the time, or if a newcomer to the industry, such as a cooperative feedlot association is involved, the plant's potential marketing position must be thoroughly appraised under the assumption that it will operate as an independent firm. Three basic marketing alternatives are generally open to an independent packer.

First, the plant's beef output could be marketed under contract or market agreement. Under either arrangement the volume, quality, product form, and price schedules would be specified in the contract before production started. Precise scheduling of cattle flow would be needed from farms and feedlots to and through the slaughter plant to the contractor's refrigerated warehouses.

The second alternative would be to consign the plant's production to one or more bonded brokers or agents. This is similar to marketing under contract, except that prices would vary more in response to changes in market conditions, and volume requirements would be difficult to predict. The consignees would determine product specifications and other necessary sales requirements.

The third alternative would be for the proposed firm to have its own sales force or retail outlets. This distribution approach would require making marketing decisions for promotional work to establish a reputation for the firm and for pricing policies that would attract enough buyers to reach the desired sales volume, but yet high enough profit margins to cover the added costs of a fully staffed sales department. It would also require directing and coordinating the activities of salesmen, who would sell carcass or boxed beef to retail stores, hotels, restaurants, and institutions. Small potential operators might want to establish their own retail outlets to sell direct to consumers.

The first two alternatives relieve management of much of the responsibility for marketing but weaken the firm's overall bargaining position by depending too exclusively on one or a few outlets. Nevertheless new firms may wish to consider some form of contracts or consignments, at least in the beginning. None of these alternatives should be ruled out before the plant's overall marketing opportunities have been analyzed.

The marketing investigation itself will include selecting specific sales territories and surveying meat-affiliated firms within these demand areas to determine the probability of successful market entry. Selection of the proposed trade areas should be based on optimum distribution patterns developed from an investigation of the following factors: (1) Distances and transportation costs from the proposed plant location to high beef consumption areas, (2) existing levels of sales competition within alternative markets where the plant would have a comparative transportation advantage over competitors in other areas, (3) demand characteristics and population trends within these various market areas, and (4) each market area's pricing policies and practices. Potential customer accounts to survey include corporate and voluntary chains; independent wholesalers; hotel, restaurant, and institutional purveyors; brokers and commission agents; and local, State, and Federal governments.

Those involved in analyzing the market potential for a cull-beef operation might also include food processors and meat-manufacturing firms. This of course would depend on whether the slaughtering firm intended to process its own meat or market it as unprocessed, boneless beef.

The evaluators should also survey suitable outlets for the plant's byproducts. Packinghouse byproducts include animal fats, both edible and inedible; hides; tankage, dried blood meal, and bonemeal feeds; glands; and gelatin and glue stocks. Suitable markets will also be needed for variety meats, such as head meat, hearts, livers, kidneys, tripe, tongues, and oxtails.

The scope of this task is so formidable that mail or phone surveys should be substituted for personal interviews. Specific information to be obtained from the questionnaires includes (1) the volume of beef sold by the firm in the preceding year and any increased needs that can be foreseen; (2) how much of this volume might be ordered from the new packer; (3) the firm's method of establishing prices; (4) the firm's specifications for fresh beef purchases, including quality, product form, delivery scheduling, and any legal considerations; and (5) its procurement methods and the normal period between delivery and payment for purchases. Followup personal interviews with the most promising prospects can provide additional data for the analysis.

The results of this marketing survey should then be compared with the plant's projected annual output. If the marketing potential appears favorable, a distribution program should be planned according to the most favorable marketing alternatives.

A market appraisal for a new *local* packer requires a somewhat different approach than that described for national, regional, and sectional packers. The opportunities to develop local outlets normally are rather limited. For a clear picture of the actual market potential, the evaluators must consider as a distribution territory that area within which the plant's location gives it an advantage over other packers selling beef in the area. The total beef consumption in this given area should be measured. Current population statistics for the trade area multiplied by local per capita beef consumption will give an estimate of the trade area's total demand potential less that supplied by farm slaughter. Where the population is declining, the resident statistics must be adjusted to realistic future totals.

If local per capita beef consumption is unknown, it can be estimated by comparing rural household beef consumption for the area, as shown by Rizek and Rockwell (*58*), with the national average use of beef in households. The ratio between the figures can be used to inflate or deflate average figures on U.S. per capita beef consumption for the most current year available.

The evaluators must then consider the packers and meat distributors currently serving the area to determine whether the new plant's output would meet severe competition. Local outlets should be contacted to obtain data. If the plant's projected output is greater than can be marketed locally, more distant markets would be needed for the surplus, or the plant's kill would have to be scaled down until the firm was able to acquire a greater share of the local market.

Successful local marketing will require a combination of competitive pricing policies, improved services, high quality, consistent volume, and a strong promotional program.

Distribution Requirements

Dependable transportation service and the cost of that service to get the product to market are critical considerations in any industrial development plan. This is particularly true in determining feasibility for rural packing plants since they merchandise a highly perishable commodity. Advantages of locating plants away from urban demand centers are reduced somewhat by the need to deliver the final product—beef—to the consuming public. Near completion of the Nation's interstate highway system and past reductions in rail rates have helped shrink this disadvantage.

Most interregional fresh beef rail shipments now move by piggyback refrigerated trailer. The vans are loaded at the packing plant, transferred to flatbed railcars, and shipped. To meet over-the-road competition, rail carriers now provide ramp-to-ramp service, eliminating the need for pickup and delivery. Overall, however, motor carrier transportation dominates the movement of fresh meat to market in the United States. According to the best available estimates, trucks now move about 90 percent of all fresh meat supplies (*55*). The latest available census of transportation shows that truck cartage accounted for 81.3 percent of all meat and meat products transported during 1972, whereas rail movement accounted for 18.5 percent (*97*). The remaining 0.2 percent was attributed to all other forms of transportation.

When truck and rail freight charges are compared on a service-equivalent basis, motor carriers generally have an advantage over rail carriers for short hauls, whereas railroads have the advantage in most long hauls. In the packing industry, trucks are generally considered to have the advantage over rails for hauls under 300 miles. Although one study (*24*) shows that trucks have a clear-cut advantage over rails for only the first 98 miles when hauling such commodities, the data are based on costs to the transportation industry rather than charges to the user. Nevertheless truck transportation offers speed and flexibility, which are critically important for movement of perishable products. Consequently, efficient load scheduling, minimum delays and time in transit, as well as prompt deliveries can become as important or often more important than freight differential charges. Also, deliveries made on schedule help to assure repeat sales. Carrier reimbursements for loss and damage claims on spoiled meat in transit can never really offset or compensate for the loss of a good customer account.

The most common truck used to haul fresh meat is a five-axle tractor semitrailer, which is 40 feet long. With the maximum gross weight allowed in most States of 73,280 pounds, this vehicle has a maximum payload capacity of 43,010 pounds. However, this maximum load could probably be obtained only in transporting packaged meat. Hanging dressed beef would probably be somewhat less (*56*). Most packers use an average figure of 40,000 pounds per load when estimating their shipping equipment requirements for carcass beef. Some use 38,000 to 39,000 pounds per load as their average for hanging carcass beef. In both cases, similar figures are used for piggyback shipments of hanging beef. Western packers utilizing over-the-road 54-foot twin trailers (27 feet each) normally estimate their hanging meat payloads at 43,000 pounds, although the maximum payload capacity for such refrigerated rigs is 46,530 pounds in many Western States.

Nationwide refrigerated railcar payloads for hanging meat are generally estimated at 50,000 pounds, whereas boxed variety meats and the like average about 125,000 pounds per 50-foot railcar.

For an independent packer just getting established, common or contract motor carrier service may be more practical than leasing or owning transportation equipment. The method used will depend largely on the firm's financial position and the distance to prospective outlets, as well as on the relative availability of adequate rail service. A rail siding to the plant has the advantage of flexibility, although nearby piggyback service will suffice for those planning to serve distant markets. Nevertheless many large-scale packers rely entirely on railroads to move their refined fats and oils, tankage, and other animal byproducts. This is the principal reason why many install a rail spur and rail docks at their facilities even though practically all their fresh meat shipments travel by refrigerated trucks.

To determine the availability, dependability, and adequacy of existing local transportation, the evaluators should investigate the following factors:

For motor carrier service:

(1) The number of local common and contract carriers.

(2) Rates and charges, including minimum load qualifications for the lowest rate.

(3) Type, condition, and availability of refrigeration equipment.

(4) The capacity of local services to meet peak load demands as well as normal anticipated shipments throughout the year.

(5) The opportunities to consolidate deliveries.

(6) The in-transit time to proposed outlet destinations.

(7) Humidity and temperature control maintenance in transit.

(8) Provisions for security and damage claim adjustments.

(9) Extent of freight damage adjustments made recently by local services for refrigerated food shipments.

(10) Extent of past labor problems, if any.

(11) Maintenance of service during bad weather, such as snowstorms.

(12) State highway limitations on size and weight of vehicles.

For rail carrier service:

(1) The number of railroad lines serving the community.

(2) Rates and charges, including minimum load qualifications for the lowest rate.

(3) Typical local supplies of refrigerated piggyback vans and railcars and their condition.

(4) Seasonal fluctuations of van and car supplies for the local area.

(5) Outbound service routes and transit times to proposed outlet destinations.

(6) Humidity and temperature control maintenance in transit.

(7) Provisions for security and damage claim adjustments.

(8) Extent of freight damage adjustments made recently by local services for refrigerated food shipments.

(9) Extent of past embargoes resulting from labor strikes.

(10) Alternate service in case of labor strikes or bad weather.

(11) Car size and weight restrictions.

(12) Possibility that a railroad line will extend trackage to the plant site.

For transportation of meat products, rates and charges for both commercial trucks and rail service are under the direct authority of the Interstate Commerce Commission. Agricultural commodities, including livestock, fish, and certain unprocessed commodities, are exempt or free from the Commission's regulations. Local carriers or the Commission itself can provide any more specific information desired.

INSPECTION AND GRADING

Federal meat inspection is mandatory for all meat products destined for interstate commerce. Those planning to establish a plant with slaughter capacity greater than that needed for local and nearby consumption should consider using Federal inspection to expand their market distribution potential. Many outlets, such as food chains and large wholesalers, require that meat be federally inspected even when it is not shipped across State lines.

Federal Meat Inspection

Federal meat inspection service is administered by the Food Safety and Quality Service of the U.S. Department of Agriculture. Its purpose is to assure the wholesomeness of all meat and meat products entering interstate and foreign trade. It includes Federal inspection of animals before, during, and after slaughter. If the meat is further processed, the Department inspects it during all additional steps. The meat inspection service also regulates and controls the facilities, equipment, and sanitation in all meat plants operating under Federal inspection. It has authority to approve or disapprove all labels used for meat products processed in these plants.

The basic cost of this inspection service is paid by the Federal Government. However, the packer is required to pay USDA for overtime service. Maintenance costs necessary to meet Federal inspection requirements, as well as any losses resulting from condemnation of animals or carcasses, must be borne by the packer.

Before a packing plant is granted Federal inspection, blueprints consisting of plot, floor, and plumbing plans of the entire plant layout and specifications must be furnished to the U.S. Department of Agriculture for approval. Plot plans of the entire premises must show the locations of all buildings, parking areas, rail sidings, and roads, along with streams, catch basins, water wells, reservoirs and storage tanks, and the sewage-disposal system. Prior to the inauguration of inspection, the plant operators must have letters stating that the water system is potable and the sewage system is acceptable. These letters must be obtained from responsible local authorities.

Trained USDA personnel review the blueprints to make sure that all aspects of receiving, slaughtering, processing, and shipping are acceptable. The plant must be carefully designed to provide sanitary procedures that will produce wholesome meat products. Recommended guidelines for designing, building, and maintaining meatpacking plants to operate under Federal inspection can be obtained from the U.S. Department of Agriculture (*81*).

After the firm's application and blueprints have been approved and the plant has been built, Federal inspectors will be assigned to the plant to provide inspection service for 40 hours per week, not to exceed 8 hours per day. Daily weekday hours over this limit are considered overtime. The inspection fee charged to packers in 1977 for each USDA employee for overtime service was $13.20 per hour, including Saturdays, Sundays, and holidays, and $19.92 per hour for any requested laboratory services beyond normal inspection requirements.

Each approved packing plant is given an establishment number, which is to appear on all carcasses inspected and passed at the plant. No minimum slaughter volume is required for plants to be eligible for Federal inspection service. Workable arrangements can be made to serve the inspection needs of even very small plants that may kill animals only 2 or 3 days a week. Established small packers who seek to qualify for Federal inspection should have their plans approved by the U.S. Department of Agriculture before making any alterations to enlarge or improve the efficiency of their facilities. Specific information about updating and qualifying old facilities to meet Federal requirements can be obtained from the Department (*85*).

State Meat Inspection

The Federal Wholesome Meat Act of 1967 required that by December 15, 1970, all nonfederally inspected meatpacking plants throughout the country should be provided with State inspection service comparable to that of the Federal Government. This means that packers doing business within their own State must have their livestock inspected by State personnel before, during, and after slaughter. They must also provide sanitary plant standards at least equal to Federal requirements. To be acceptable, facilities and equipment must be clean and capable of being kept clean. These requirements are intended to insure that meat products are prepared in sanitary surroundings. The purpose is to assure consumers of a sanitary, wholesome meat supply and not to impose strict standards that might force small, nonfederally inspected plants out of business (*83*).

Packers who expect to ship meat only within their own State should contact their respective State inspection agencies for specific regulations about plant design and details about sanitation requirements. Among the critical considerations for either constructing new plants or improving old ones are water supplies, drains, floors, walls, doors and doorways, lighting, refrigeration equipment, meat rails and plant equipment, and the inspectors' needs.

As of December 31, 1976, 33 of the 50 States had established and have continued to conduct their own State meat inspection programs certified as meeting Federal inspection standards. The following States are without such State programs: California, Colorado, Connecticut, Kentucky, Massachusetts, Minnesota, Missouri, Montana, Nebraska, Nevada, New Jersey, New York, North Dakota, Oregon, Pennsylvania, Tennessee, and Washington. Although the Federal Government has assumed responsibility for meat inspection in the absence of an approved State program, this does not entitle packers in these 17 States to make interstate shipments unless they specifically apply for and receive approval as a regular federally inspected plant.

Talmadge-Aiken Inspection Program

In accordance with Public Law 87–718, signed into law on September 28, 1962, a cooperative Federal-State meat inspection program was established. The four basic principles used to develop and identify this cooperative meat inspection agreement between the U.S. Department of Agriculture and State departments of agriculture and related agencies are as follows: (1) That the inspection will conform in all respects to the Federal requirements; (2) that the inspection will be conducted by federally approved State employees with such supervision by Federal employees as may be needed to assure that Federal inspection requirements are met; (3) that the cost of the program will be borne by the individual State from public funds; and (4) that establishments operating under such a program will be eligible to ship meat and meat food products in interstate or foreign commerce.

This law was established after it was determined that frequently the administration of such programs within a State by competent State agencies and personnel avoids duplication of functions, results in greater effectiveness, and permits economy in administration. As of December 31, 1976, 18 States were participating in this cooperative program by conducting Talmadge-Aiken inspection for the U.S. Department of Agriculture. The following States have such T-A plant inspection programs: Alaska, Arkansas, Delaware, Georgia, Hawaii, Illinois, Indiana, Kansas, Louisiana, Maryland, Michigan, Mississippi, North Carolina, Ohio, Oklahoma, South Carolina, Utah, and Virginia.

Federal Meat Grading

Federal meat grading is sometimes confused with Federal meat inspection. Carcasses that have been both federally inspected and graded carry three types of colored markings. Two of these markings are applied to animal carcasses by the Federal meat grading service. A ribbonlike stamp with the letters "USDA" and a grade such as "CHOICE" set within a shield indicates the meat quality of the carcass. A similar ribbonlike stamp with the letters "USDA" and a number such as "2" set within a shield indicates the amount of salable trimmed meat that the carcasses will yield. The third type of colored marking on such carcasses is the circular inspection stamp applied by Federal meat inspectors. This stamp, which reads "U.S. INSPECTED & PASSED," denotes that the meat is wholesome and free from disease and has been processed under sanitary conditions. It also carries the identifying number of the specific plant where the carcass was processed. Meat that has been inspected for wholesomeness by a State may be graded by Federal graders if the packer desires this service.

The function of the Federal meat grading service is to provide nationally uniform guidelines for meat quality and yield. Meat quality indicates differences in meat palatability. U.S.

Department of Agriculture quality grades range in descending order from Prime, Choice, Good, Standard, Commercial, and Utility to Cutter and Canner. Each grade indicates a specific level of carcass quality. Carcasses meeting the standards of the top four quality grades are usually from young grain-fed cattle and are sold as dressed beef. The remaining four grades—Commercial, Utility, Cutter, and Canner—usually designate meat from more mature animals to be used in processed meat products.

In 1965, official Federal standards were developed to measure the yield of major boneless retail cuts in a beef carcass. These standards indicate the amount of salable trimmed beef that a carcass will yield. Any of five yield grades may be applied to carcasses in each of the USDA quality grades. Yield grade 1 represents the highest yield of retail cuts, and yield grade 5 represents the lowest. Yield grades allow packers to identify their beef more precisely and enable retailers to specify standardized grades of leanness rather than make up restrictive private specifications. Such yield grading service no longer is left to the option of the meat packer. The yield identification must be applied along with the quality grade stamp if a packer requests such Federal meat grading service.

Although Federal inspection is provided at no cost to the packer except for overtime, the entire cost of Federal grading is paid by the packer. This cost covers salaries and benefits of the USDA grading personnel, operating costs, and administrative overhead. The hourly rate for Federal grading in 1977 was $19 for service between 6 a.m. and 6 p.m. from Monday through Friday. The hourly rate for weekday overtime and Saturdays and Sundays was $23 and for holidays it was $38, twice the base rate.

The Federal grading service can be extremely helpful to new operators attempting to develop market outlets, since their dressed beef will be evaluated according to the same standards as beef from established plants. This standardization under the Federal grading system enables new independent beefpackers to sell similar quality on a competitive level with nationally known packers. Retail beef advertisements frequently carry Federal grade labels rather than individual packer brand names.

Since the cost of Federal grading is borne solely by the packer, the benefits must be appraised against the costs to determine whether the plant will profit from this service.

CAPITAL INVESTMENT REQUIREMENTS

Financial requirements for establishing beefpacking plants include two basic components—fixed investment capital and operating capital. Funds are needed to build and equip the facility, and additional amounts are needed to carry on business activities, such as purchasing cattle, slaughtering, merchandising, and extending credit to outlet accounts.

The specific amounts of fixed investment capital needed depend on plant size and function as well as on prevailing construction and equipment costs and current land values. Since these costs vary widely with time and locality, the fixed investment estimates shown in table 5 for small, medium, and large cattle-slaughtering facilities are intended only as being representative of those during 1976. They are fairly typical of costs in mid-America, where many new plants are being constructed. Sufficient land has been allocated in each cost estimate to handle plant expansion and lagoon acreage needs if an independent sewage-treatment system should be required. The estimates of building and equipment costs were obtained from the engineering department of Koch Supplies, Inc., in Kansas City, Mo. Estimated costs for freshwater and wastewater-treatment systems were obtained from Bell, Galyardt, and Wells, sanitary engineering consultants, in Omaha, Nebr. Estimates of land values are from the Guymon, Okla., Chamber of Commerce.

Although these plant costs may be viewed as typical, architects and engineers warn that superior quality construction, which provides durability and therefore longer, useful plant life, can raise costs appreciably higher than the estimates in tables 5 and 6. In other words, construction quality can also have an impor-

TABLE 5.—*Estimated capital investment requirements for 3 sizes of cattle-slaughter plants in 1976*

Item	Capital investment by plant size in kill capacity per hour		
	20 head	60 head	120 head
Land[1]	$142,500	$345,000	$510,000
Site work[2]	12,000	30,000	48,000
Building	671,893	1,493,646	2,427,604
Equipment	321,325	733,610	1,356,310
Water system[3]	101,000	181,000	280,000
Sewage-treatment system[4]	145,000	268,000	349,000
Paved areas	8,849	22,471	44,298
Corrals	87,120	250,200	423,630
Architect's fee[5]	46,072	105,979	173,732
Total[6]	1,535,759	3,429,906	5,612,574

[1] Land requirements and costs are based on the following estimates: (1) For the 20-head-per-hour plant, 25 acres @ $5,700 per acre; (2) for the 60-head-per-hour plant, 75 acres @ $4,600 per acre; and (3) for the 120-head-per-hour plant, 150 acres @ $3,400 per acre. These estimates are for raw land serviced by a hard-surfaced road and with track frontage, or with the potential of extending a rail spur to the site. Land costs for similar rural industrial sites without rail potential would be somewhat less. Treated wastewater discharge by irrigation would significantly increase these land requirements.

[2] These estimates are minimal. Site clearing requiring demolition and removal of existing structures or extensive filling, grading, or piling improvements can increase costs substantially.

[3] Cost estimates for a potable freshwater system can vary widely depending on well depth, well distance from plant site, storage capacity needs, and pressure pumping requirements.

[4] Cost estimates for wastewater treatment can vary widely depending on the type of treatment system selected, year-around weather conditions at the plant site, and other variable factors. These estimates exclude the costs of land for sewage-treatment needs as well as acreage for irrigation purposes and irrigation pumping and spraying equipment.

[5] This fee is based on 6 percent of the construction costs for the building, paved areas, and corrals. Although 6 percent might be considered average, the actual charge normally varies from 5 to 7 percent, reflecting plant size and the extent of work required of the architect. Some clients require more service than others.

[6] These totals are for kill-and-chill plants only. See p. 65 for additional construction and equipment cost estimates for carcass-breaking and boxing facilities, which could be installed in conjunction with a new kill-and-chill packing plant.

tant role in price estimating along with plant size, function, locality, and time of construction.

Facility space requirements as well as other estimates were based on data developed in an Oklahoma study on economies of size in cattle-slaughter plants and on supplemental data from a California study on the same subject (*23, 44*). Tables 6 and 7 show estimates of the floorspace and equipment requirements for each of the three sizes of plants. Such modern packing plants have kill floors with on-the-rail slaughter systems, which are fitted with mechanical hoists and overhead conveyors and are equipped with such devices as hydraulically operated deboners, hock cutters, hide pullers, and lift platforms. Electrically operated splitting saws, air-powered knives, and other labor-saving devices are also used. High-volume operations in the medium-to-large plants also use a moving-top viscera table positioned directly below the moving chain conveyor supporting the carcasses.

TABLE 6.—*Estimated facility requirements and construction costs for 3 sizes of cattle-slaughter plants in 1976*

Facility area	Construction costs and space requirements by plant size in kill capacity per hour								
	20 head			60 head			120 head		
	Construction cost	Floor area	Total cost	Construction cost	Floor area	Total cost	Construction cost	Floor area	Total cost
	Dollars per sq ft	*Sq ft*	*Dollars*	*Dollars per sq ft*	*Sq ft*	*Dollars*	*Dollars per sq ft*	*Sq ft*	*Dollars*
Kill floor	69.30	1,750	121,275	63.00	5,142	323,946	56.70	8,970	508,599
Chill cooler[1]	77.00	1,710	131,670	70.00	4,692	328,440	63.00	8,964	564,732
Sales cooler[1]	77.00	2,247	173,019	70.00	5,472	383,040	63.00	10,527	663,201
Refrigeration	36.30	240	8,712	33.00	800	26,400	29.70	800	23,760
Boiler	36.30	200	7,260	33.00	442	14,586	29.70	540	16,038
Hide curing	38.50	1,400	53,900	35.00	3,000	105,000	31.50	5,500	173,250
Rendering	46.20	1,500	69,300	42.00	2,825	118,650	37.80	5,000	189,000
Equipment cleanup	30.80	224	6,899	28.00	224	6,272	25.20	224	5,645
Dry storage	30.80	150	4,620	28.00	344	9,632	25.20	687	17,312
Welfare and cafeteria	30.80	600	18,480	28.00	1,280	35,840	25.20	2,740	69,048
Offices[2]	39.60	1,320	52,272	36.00	2,880	103,680	32.40	4,800	155,520
Refrigerated docks[3]	58.30	420	24,486	53.00	720	38,160	47.70	870	41,499
Average or subtotal[4]	57.12	11,761	671,893	53.68	27,821	1,493,646	48.92	49,622	2,427,604
Dock aprons	1.50	840	1,260	1.50	1,440	2,160	1.50	1,740	2,610
Parking lots	.80	9,486	7,589	.80	25,389	20,311	.80	52,110	41,688
Corrals[5]	9.90	8,800	87,120	9.00	27,800	250,200	8.10	52,300	423,630
Total[4]	----	30,887	767,862	----	82,450	1,766,317	----	155,772	2,895,532

[1] Both the chill and sales coolers for each size plant have sufficient storage-holding capacity for 1 day's kill in each room.

[2] Includes office space for meat inspectors.

[3] Docks are enclosed, insulated, refrigerated, and fitted with insulated doors, dock seals, and bumper guards.

[4] Exclusive of architect's fee, installed refrigeration, and other in-plant equipment. When costs for the building, all in-plant equipment including the refrigeration, and the architect's fee are consolidated into one cost and divided by the amount of floorspace for each size of operation, the cost per square foot of facility amounts to (1) $87.48 for the 20-head-per-hour plant, (2) $83.04 for the 60-head-per-hour operation, and (3) $78.83 for the 120-head-per-hour plant.

[5] Corral cost estimates are based on the amounts of penning areas, alleys, gates, and fencing necessary for each size plant. One-fifth of each plant's corral area is provided with a weathertight roof. Cattle-holding capacities for each plant's corrals are equivalent to 2½ days' kill.

TABLE 7.—*Estimated equipment requirements and costs for 3 sizes of cattle-slaughter plants in 1976*

Equipment for—	Requirements and costs by plant size in kill capacity per hour		
	20 head	60 head	120 head
Refrigeration:			
Chill cooler tons	43	125	248
Sales cooler do	12	30	66
Total do	55	155	314
Refrigeration, installed:			
Per ton dollars	1,875	1,625	1,500
Total do	103,125	251,875	471,000
Kill floor, installed do	44,400	180,000	282,000
Rendering, installed do	144,000	240,000	480,000
Hide curing, installed do	19,450	38,900	77,800
Office, installed do	10,350	22,835	45,510
Total cost do	321,325	733,610	1,356,310

These plants with kill capacities of 20, 60, and 120 head per hour are designed as kill-and-chill operations to produce dressed-carcass beef. Facilities for offal workup on the kill floor and the rendering of inedible byproducts are included, but no provision was made for curing hides in the Oklahoma and California studies. All hides were expected to be sold daily on a "green" or fresh basis. However, such hide-curing facilities and equipment have been included in the plant construction estimates given in tables 5–7. Estimates of equipment costs and space needs to prepare brine-cured hides were obtained from Challenge-Cook Bros., Inc., in Industry, Calif.

High-volume packers now have an additional alternative for marketing their hides. An advanced, new hide-processing system that partially tans hides is available. Such "blue chrome" hides command better prices because they are free of salt stains and wrinkles and permit tanners to skip several primary processing steps (*111, 112*). However, additional mechanical inputs, such as fleshing devices, as well as more sophisticated processing equipment, based on 1976 estimates would cost a packer operating at 120 head per hour $218,000, or more than three times the cost of equipment to produce brine-cured hides.

For construction and equipment cost estimates of facilities to break and box carcass beef, see the last section of this handbook on New Industry Trends.

The need to maintain adequate working capital on hand cannot be overstressed. Lack of it is a common cause of business failure for old as well as new firms. Owing to the unique buying and selling practices of the meat industry, packer requirements for operating capital are substantial. Current bench-mark ratios of "fixed capital" to "operating capital" requirements for cattle kill-and-chill operations are about 1 to 0.95 for small operators, 1 to 1.27 for medium-sized ones, and 1 to 1.50 for large packers.

Packers, by law, are required to pay for their raw-material livestock procurements within hours of purchase. Yet on the other hand they often are obliged to wait weeks to collect from their customers. Consequently, packers always have considerable sums of capital tied up in their accounts receivable. Normal settlement periods for accounts receivable have averaged from 10 to 14 days, but the length of these settlement periods is increasing. Some packers now wait from 10 to 30 days to collect their money. Cash outlays to cover potential bad debt accumulations also increase the need for working capital.

Specific amounts of working capital requirements depend on many other variables as well. Current cattle and beef prices, current wage rates that affect plant employee payrolls, nonlabor operating expenses, and beef inventory levels on hand are some items. The level of plant use is also important. Normally to enable a packing firm to meet its current operating expenses and fixed future obligations, about 5 to 8 percent of its annual operating costs, including raw-material procurements, must be continuously available in cash credits throughout the year.

Besides the cash needed for normal business activities, startup capital is needed for promotional programs and training the work force. A contingency reserve should also be set aside for emergencies and for unexpected increases in operating expenses. Therefore specific recommendations for cash-on-hand needs can be made only after the evaluators determine all current cost inputs and typical credit extensions to be granted to accounts at the time and place of the study. This is equally true of fixed plant investments.

When computing the necessary operating capital requirements, the evaluators must assume that the proposed plant will operate the year round at a given percentage of its rated line speed, preferably 100 percent or better. Line stoppages or "downtime" for veterinary inspection delays, bottlenecks, and two rest periods typically reduce work time during an 8-hour shift by about 10 percent, making the actual productive time per day about 7.2 hours. To compensate for this, many packers increase their kill-line speeds about 10 percent above the plant's normally rated kill capacity so that their chill-room carcass count will equal a full 8-hour day's production at the plant's rated line speed. For example, in a plant set up to operate at a kill of 60 head per hour, the chain speed is increased to 66 head per hour. This practice, however, requires extra labor and rebalancing the kill-floor crew. Additional computations in the Oklahoma study consider six operating levels, ranging from 90 to 115 percent of each plant's rated line speed.

Cost inputs used to estimate annual in-plant operating expenses for a proposed beefpacking plant are summarized in exhibit A (appendix). Sources for developing detailed estimates of these costs as well as formats for determining plant depreciation allowances, equipment writeoffs, and other accepted accounting procedures can be obtained from the Oklahoma study (*23*) and other published research data (*29*, *31*, *44*). Once the annual in-plant costs are derived, then livestock procurement costs and meat and byproduct sales and distribution costs must be estimated.

Economies of Plant Size

Many types of agricultural processing firms are participating in the general trend toward large-scale, automated operations found in other nonfood industries. Economies of plant size are achieved when average unit costs of production decrease as plant size increases. If these unit costs are reduced significantly, there will be a tendency within the industry toward construction of larger plants as smaller, high-cost plants are forced out by competitors with lower operating costs.

Production economies in the packing industry are possible with the new technologies in kill-floor equipment and plant design, improved labor utilization, and the trend toward specialization in only one animal species. Normally a modern on-the-rail beefpacking plant killing 60 head per hour can reduce per-unit slaughtering costs to achieve economies of plant size if the plant is operating at or near its rated line speed.

Since 1950 the meatpacking industry has changed from a concentration of slaughter capacity under a few dominant packers converged in urban areas to a growing number of rural-oriented, medium-sized independent firms. More recently the number of large rural-oriented independent firms is increasing.

Although Franzmann and Kuntz (*23*) found diseconomies in plant size as productivity increased beyond 60 head per hour, a study by Logan (*42*) in 1965 indicated that further economies are possible as plant size increases beyond 60 head per hour. Logan's study deals with on-the-rail plants ranging in capacity from 20 to 120 head per hour without cold offal workup and rendering. Operating costs in the study represent the Omaha, Nebr., area. The report is essentially an updated version of one by the same author on economies of scale, using 1960 Los Angeles, Calif., data (*44*).

However, plant size is not the only criterion for competitive strength in the packing industry. Benefits attributed solely to plant size can be misleading. Plant operating efficiency can be offset by cattle shortages and excessive cattle procurement costs. A modern automated plant can easily experience diseconomies in its overall operations. For example, if a 180-head-an-hour plant operated at only 60 percent of its rated line speed because of a local shortage of raw material, and if operating even at this level made it necessary to buy cattle from as far as 500 miles away, such a plant could experience diseconomies in overall operations.

Economies in plant size may also be offset by other factors. Efficient beef distribution and customer service are very important. Large plants that pay high transportation costs to ship their beef into isolated demand centers may be at a disadvantage in competition with small local packers. Plants in isolated areas often can cater to their local clientele by performing services that distant suppliers would have difficulty in duplicating. For example, a small local packer, killing only 10 head per hour but performing such additional functions as custom meat processing and wholesaling to hotels and restaurants, might satisfy a small local demand at a profit, even though the firm's per-unit slaughtering costs were comparatively high.

Integration of small plant activities can improve the use of labor. Such joint use of facilities, labor, and management for operations beyond slaughtering can increase overall profit margins and help reduce per-unit average slaughter costs (*60*). Area wage rates also affect plant expenses and thus per-unit slaughtering costs.

Financing Sources

The method used for capital financing will have an important effect on the packing-plant budgeting analysis, since interest costs will be reflected in annual operating expenses until all capital loans have been repaid. Evaluators should work with community leaders and others to find the most advantageous basic plan to finance the project. Interest rates and other pertinent financial information used in the calculations must reflect conditions prevailing at the time of the study.

Financing of a new packing plant normally depends on the organizational structure of the firm and whether the planners are established packers or newcomers to the industry. A packing plant can be operated as an individual proprietorship, as a partnership, or as a corporation. A cooperative association is another type of organization that has become popular among some feedlot operators trying to improve their profit opportunities by integrating forward into slaughter operations.

Established packers seeking funds for new plant construction have immediate access to internal capital sources, such as retained earnings and depreciation allowances. Other capital-generating options include issuing new stock, debentures, or bonds. These are in addition to conventional loans from commercial lending institutions.

New independent firms normally have fewer sources of investment capital. Bankers and other lenders consider them potential high risks, particularly if they lack management experience. Newcomers to the industry usually raise funds first through owner equity, then through local private investors and public financing, and finally through commercial lending institutions. Those with sufficient personal wealth could, of course, finance their own construction.

Often small businessmen can obtain local capital from individual investors by legally incorporating the firm and issuing stock and debentures. Sales to community residents and friends are possible, since these people would be familiar with the individual's management ability. In capitalizing such a corporation, care must be taken to protect owner control.

Another possible outside source of partial long-term capital is the public market for corporate securities filed under regulation A of the Securities Exchange Act (*21*).

A number of States have passed legislation establishing development corporations to promote economic and social community development through financial assistance. Several types of such industrial financing programs are generally available to help establish rural packing plants as well as other industries. One such program is through the use of industrial development bonds.

Industrial development or industrial aid bonds are issued by State or local governments to raise capital for acquiring or improving a commercial site and building a plant, which then can be leased to a private corporation. The lease is generally for 25 or more years. It normally contains a clause giving the private firm an option to purchase the land and facilities outright when the lease expires. The bonds may be obtained as nonguaranteed revenue bonds, or, where the town acts as cosigner with the firm, they may be obtained as general obligation bonds. The repayment of nonguaranteed industrial revenue bonds depends solely on rent payments from the firm for whose benefit the bonds are issued and on the capital asset they finance. General obligation bonds are repaid by similar rents, as established by the lease, but they are backed by the full faith and credit of the issuing government. Since nonguaranteed industrial revenue bonds must be marketed on the basis of the firm's credit rating, they are generally useful only in financing well-established companies. General obligation bonds are typically used for small or new corporations.

Most States have some form of public industrial financing program to promote such rural economic growth. Planners should investigate the availability of industrial aid financing through local industrial development bond issues, State industrial development authorities that make loans to local nonprofit development corporations, and State loan guarantee programs (*53a, 53b, 103a*).

Commercial banks are a versatile source of short-term loans for working capital. Although collateral requirements and loan terms are normally flexible, most commercial banks hesitate to extend credit in excess of a firm's collateral assets. The most frequent reason given for turning down loans is too little owner equity. Most banks offer long-term credit, but they prefer short-term loans, which enhance the liquidity of their own assets. Most prefer making long-term loans only to finance land, buildings, and equipment, which themselves can be used as security.

Although banks generally hesitate to extend funds for new businesses, loan officers often consider the personal integrity and ability of the individual seeking money for a new venture. Small banks, acquainted with an individual's abilities but not able to extend the size of loan requested, can recommend the borrower to their correspondent banks or arrange participation loans through their correspondent banks.

An alternative to conventional lending sources for working capital is commercial finance companies. However, interest rates are normally higher than prevailing bank rates, and this form of financing is generally considered only as a supplemental or as an interim source of loans.

Private financing through savings and loan associations, life insurance companies, and bank trust departments generally is not promising for the packing-plant operator seeking capital. These organizations are typically conservative among commercial lending institutions.

Manufacturers of packinghouse equipment normally prefer not to extend credit, but they will help finance new equipment purchases if necessary. They generally require a 25-percent down payment in cash and terms of from 2 to 5 years to pay off the balance with accrued interest at prevailing rates.

If complete industrial financing is not obtainable from private sources, loans from certain Government agencies can be made available (*66, 80*). These Federal financing programs are not intended to supplant other sources of financing but to provide additional capital when it is needed to make sound development possible. These Government agencies that provide such assistance are the Economic Development Administration, the Small Business Administration, and the Farmers Home Administration. The first two agencies are a part of the Department of Commerce and the third is an arm of the Department of Agriculture.

Economic Development Administration

The Economic Development Administration (EDA) provides low-interest, long-term loans to either new or expanding businesses in designated redevelopment areas. Typically these are areas of significant unemployment and low income. Loans of as much as 65 percent of the total cost of the project, including land, buildings, and equipment, may be made for up to 25 years at a rate of interest based on Federal borrowing costs. The loans are made only for business ventures that cannot obtain financing through banks or other commercial lending institutions. Federal guarantees for working-capital loans made by private institutions in connection with these projects are also available.

At least 15 percent of the total cost of the project must be supplied either in the form of equity capital or as a loan subordinated to the Federal loan. EDA loans are generally made in excess of $500,000. Loan applications are evaluated on the merits of the project's economic soundness and on the employment potential that the project will generate.

Small Business Administration

The Small Business Administration (SBA) is authorized to make loans to small business firms that cannot obtain financing through conventional channels. For loan purposes, the SBA defines a small business as one that is independently owned and operated and is not dominant in its field. A firm is generally considered small if it employed an average of 250 or fewer during the preceding year.

Loan applications can be made for construction, conversion, or expansion of facilities; for purchase of equipment, supplies, and materials; for working capital; and for debt payment in some cases. The maximum that may be borrowed through a bank and guaranteed up to 90 percent by SBA is $500,000. Direct loans from SBA, if no bank is willing to make a loan, are generally limited to $100,000. The SBA has various lending programs, but loans are primarily of two types: (1) Direct, if no bank is willing to make the loan, and (2) loans made by banks and guaranteed up to 90 percent as to repayment by SBA. A direct loan cannot be made if the funds are available through a bank or from the personal resources of the principals of the business applying for the loan.

Farmers Home Administration

The Rural Development Act of 1972 confers on the Department of Agriculture the responsibility of coordinating rural development efforts to help improve economic opportunities and community life for rural America.

One major feature of this bill authorizes the Farmers Home Administration (FmHA) to guarantee and make insured loans for commercial, industrial, and community development. Previously the FmHA's leading role was restricted to making farm, housing, and water and sewer loans. The sole purpose of expanding the agency's loan-making capacities into nonfarm categories is to provide rural residents with essential income by stimulating rural job opportunities. The results of these efforts should help stem the migration from rural areas and relieve further congestion in urban areas of the Nation.

Business and industrial loans may be made in any area outside communities with populations of 50,000 or more residents and their adjacent urban areas. This includes all 50 States as well as Puerto Rico and the Virgin Islands. Priority is given to loan applications for projects in open country and rural communities of 25,000 or less. Loans are made to (1) purchase and develop land; (2) finance construction, modernization, and enlargement of facilities; (3) acquire new equipment and machinery; (4) provide working capital; and (5) finance pollution-control projects.

Such business and industrial loans have a maximum maturity of 30 years on land, buildings, and permanent fixtures; up to 15 years for equipment and machinery or the life expectancy of such assets, whichever is shorter; and up to 7 years for the use of working capital. Interest rates are determined between lender and borrower. FmHA does not set a maximum rate and these rates may be either fixed or variable. Normally FmHA requires 10-percent equity in projects, but more may be required depending on specific circumstances.

Cooperatives

Those already in the cattle-feeding business can integrate their operations with an affiliate packing firm by forming either an open or a closed cooperative association. Packing-plant cooperatives operate for the mutual benefit of member shareholders or patrons. They are usually incorporated and controlled by farm and feedlot operators. The association is operated on an "at cost" basis, with allowances for operational expenses, maintenance, authorized improvements or expansion, and a sufficient contingency reserve. Annual profits of a cooperative are returned directly to members as patronage refunds. Normally such cooperative ventures succeed best when a high percentage of the equity is financed by the members themselves rather than from outside lending sources. The greater the percentage of member equity, the greater the member interest will be to make the enterprise succeed. Cooperative associations can acquire more capital by selling securities, retaining refunds, or borrowing. Certificates of indebtedness are widely used as security. They have priority over capital stock if assets are distributed in the event of a forced liquidation.

Financing is also available to qualified cooperatives through 12 district banks for cooperatives of the Farm Credit System. These banks for cooperatives provide permanent, specialized credit and business services to agricultural cooperatives in their respective territories. Together they serve cooperatives in all 50 States and in Puerto Rico. A central bank for cooperatives participates with these district banks on larger loans to meet the needs of borrowers for credit and other related services (*20*). Further information can be obtained from the Farm Credit Administration, which is a separate Government supervisory and regulatory agency and not affiliated with the Department of Agriculture.

LABOR AND MANAGEMENT REQUIREMENTS

Despite significant technological improvements in labor-saving equipment and plant design, meatpacking remains a labor-intensive industry. Annual payrolls and employee benefits amounted to almost 54 percent of the industry's total operating expenses from 1963 to 1975 (table 3). The bulk of this industry's employment is classified as production-line work, where needed skills are easily acquired through training. Hence surplus rural labor represents an attractive manpower pool for the meatpacking industry.

Labor

Both labor and management requirements are proportionate to plant size. Combined personnel needs average about 36, 93, and 160 employees for a 20-, 60-, and 120-head-per-hour cattle-kill operation, respectively. Specific kinds of employment needs for these small, medium, and large beefpacking plants are summarized in table 8 by occupation. Detailed job descriptions and duties for both union and salaried employees are provided in the Oklahoma study (*23*). In this study labor was less efficiently utilized in 5 work areas as output increased from 20 to 120 head per hour. This, however, does not reflect findings in other studies, but packers often vary in operating functions and degree of workup.

For example, some high-volume packers tend to employ greater numbers of workers in their salvage operations of byproducts and offals than their smaller counterparts on a comparable man-minute function basis. Such intensified activities increase the salvage yields of organ and manufacturing meats, pharmaceuticals, nonsurgical casings, inedibles for pet foods, and the like. Also, kill-floor combination jobs at lower kill-capacity rates are often not practical at higher operating levels per hour.

With the most up-to-date technologies available today, direct kill-line efficiency, as measured by the number of cattle killed and dressed per man-hour, averages about 1.6, 2.2, and 2.4 head at line speeds of 20, 60, and 120 head per hour or better, respectively. This, of course, reduces somewhat the number of kill-floor job opportunities given in table 8. However, many packers advance their kill-line speeds above their plant's normally rated kill capacity to offset production delays and consequently they require more employees. Likewise, other optional operating functions and activities of packers could also help offset this possible reduction in job opportunities.

TABLE 8.—*Labor requirements for 3 sizes of cattle-slaughter plants*

Occupation	Employees required by plant size in kill capacity per hour		
	20 head	60 head	120 head
	Number	*Number*	*Number*
Union labor for—			
Kill floor	14	34	63
Supporting kill floor:			
Hot offal	2	9	18
Cold offal	1	1	2
Cooler	4	8	12
Dock	1	4	5
Rendering	1	2	4
Hide curing	1	2	4
Maintenance	2	6	10
Cleanup	1	3	5
Yard	1	2	3
Total	28	71	126
Salaried personnel:			
General managers	1	1	1
Senior cattle buyers	0	1	1
Beef sales managers	0	1	1
Plant superintendents	0	1	1
Assistant superintendents	0	1	1
Cattle buyers	1	5	7
Beef salesmen	2	5	9
Office managers	0	1	2
Credit managers	1	1	2
Bookkeepers	1	2	3
Payroll and billing clerks	1	1	2
Secretaries	1	1	3
Switchboard operators	0	1	1
Total	8	22	34
Total labor force	36	93	160

To determine whether the positions can be filled from the local labor market, the evaluators should work closely with the State department of labor and industrial relations or the equivalent public employment agency in the study area. Employee application records are continuously being revised and updated by these local agencies.

State employment agencies affiliated with the U.S. Employment Service can help employers with recruitment. They can interview applicants, screen them by given requirements, and refer those best qualified. Information on the local labor market normally is readily available for feasibility studies.

Automated slaughter-plant skills generally are not difficult to master. Cattle are stunned, shackled, and bled; then carcasses are moved by an overhead conveyor along a processing line. Employees stationed along the line have relatively simple, repetitive specialized jobs, which eliminate the need for highly skilled job performance. Persons with limited educational backgrounds can be successfully trained to handle most in-plant assignments. In screening potential employees, the emphasis is normally on physical dexterity. Packers hiring trainees can request that local employment agencies give dexterity tests to job applicants as part of their screening.

Federal assistance is available for on-the-job training in any area of the Nation. Under the Comprehensive Employment and Training Act (CETA) of 1973, the U.S. Department of Labor will help pay the costs of on-the-job instruction designed to train the unemployed and retrain those whose skills have become obsolete. Details about such programs can be obtained through the local public employment agency in the area or through the Governor's Manpower Planning Office in the State where the study is being undertaken (*102a, 102b, 102c*).

Small packers with kills of less than 20 head per hour usually are selective in hiring, because their low-volume operations often require employees to switch from one job to another. This sharply increases the need for multiple skills. It also curtails output per man-hour. Individuals working in small plants often must be able to perform all slaughtering assignments. If packing-plant skills are unavailable within the local labor pool, experienced personnel may have to be recruited from outside the immediate area. However, small packers may wish to recruit trainees and establish an on-the-job training program also.

Employees needed for office work would be screened for special clerical skills. Efficient office procedures and a good accounting system are needed to keep management informed about daily cattle costs, production costs, and beef carcass returns, as well as to handle procurement and sales accounts.

In addition to appraising locally available manpower for qualified employees and trainees, the evaluators should thoroughly analyze the community's history of labor relations. All the following should be investigated:

(1) State and local labor laws and regulations, including whether the State has a "right-to-work" law.

(2) Safety and health laws and regulations.

(3) Local union relations, activities, collective bargaining procedures, and strike policies.

(4) Time lost due to strikes in the last 5 years.

(5) Disposition of labor disputes and boycotts.

(6) Local employee productivity and efficiency records.

(7) Local employee attitudes, conduct, and willingness to work.

(8) Local labor turnover, absenteeism patterns, and accident rates.

Wage rates vary between metropolitan and rural areas and between sections of the country. Normally data on packing-plant labor rates and fringe benefits can be obtained from the nearest local office of the Amalgamated Meat Cutters and Butcher Workmen's Union of North America, the AFL–CIO, or, in areas where cattle slaughtering is common, from the local public employment agency and nearby meatpacking-plant associations. The kind of detailed information that is available from various meat association sources (*115*) is given in the following tabulation, in which the wage rate reflects the union scale for a specific type of job in a metropolitan area:

Base Wage and Benefit Rates for a Journeyman Butcher in Metropolitan San Francisco Area, Effective Nov. 1, 1975[1]

Annual wages	$14,893.93
Employee benefits:	
FICA (5.85% × $14,100)	824.85
State unemployment insurance (3.7% × $4,200)	155.40
Federal unemployment insurance (0.58% × $4,200)	24.36
Workmen's compensation ($5.93 per $100)	883.21
Health and welfare plan (58.5¢/1,960 h)	1,146.60
Pension plan (65¢ × 1,960 h)	1,274.00
Total annual wages and benefits	19,202.35
Basic straight-time compensation per employee:	
Weekly benefits and wage before taxes	369.28
Weekly wage before taxes	286.42
Hourly wage before taxes	7.16
Annual scheduling:	*Hours*
Productive working time	1,777
Vacation (3 wk)	120
Holidays (10 days)	80
Coffee breaks	59
Sick leave	32
Funeral allowance	4
Jury duty	8
Total per year	2,080

$$\text{Employee cost} = \frac{\text{Total annual wages and benefits}}{\text{Annual productive hours}}$$

= $10.806 per productive hour or $0.180 per productive minute

[1] Entitled to 3 weeks' vacation.

Comparative earnings and benefits by selected job classification for slaughterhouse employees in various regions of the country also can be obtained from a study developed by the Department of Labor (*101*). It deals exclusively with employee occupations, wages, and benefits in the meat-products industries. Should available data at the local level prove to be insufficient, current Bureau of Labor statistical bulletins on employment and earnings (*102*) can be used to update wage rates found in the Labor Department study and thereby provide the evaluators with the tools to make a special wage-cost analysis. Similar wage data would be needed for office personnel and can be obtained by following similar procedures.

In most rural communities, workers excel in both productivity and job stability. Both of these qualities are essential for uniform slaughter scheduling and maximum plant use in the packing industry. Chronic absenteeism and job dissatisfaction can effectively cripple productivity of any slaughter plant or that of any other business. Often a firm's ability to achieve lower production costs in rural areas is due more to the able efficiency and productivity of its dependable labor force than to lower wages.

Management

Packing-plant managers must be experienced in all phases of cattle slaughtering in order to operate under sound business principles. In this industry, profit margins are too small and risks are too high for inexperienced operators. Only experience and proved ability can prevent serious startup crises from developing during the first few critical months of operation. Although activities in small plants are limited, these managers need the same qualifications to operate successfully as managers in larger plants. They must assume full responsibility for overseeing the plant's training program, for scheduling uniform production, and for arranging efficient crew balance and workflow. They also need the ability and temperament to handle labor relations problems. Good managers are keenly aware of the value of good human relations and favorable employee attitudes. Low employee morale invariably leads to production slowdowns, poor workmanship, waste and spoilage, lack of cooperation, absenteeism, turnover, and other problems. Managers must be able to motivate their employees to want to do their best. Individuals with all these management qualifications are scarce and command high salaries.

Other key management personnel within the plant include a competent kill-floor foreman and a plant superintendent. The foreman must be skilled at all kill-floor assignments and capable of instructing others to acquire these skills. The plant superintendent's duties deal mainly with plant maintenance, security, and sanitation control.

Experienced cattle buyers often can be hired locally. Most managerial and sales personnel would probably have to be recruited from outside the area, although local individuals should be considered. Sales personnel must be aggressive and versatile. Qualified persons with established customer and industry contacts are most useful to the new independent packer establishing initial accounts.

Probably the most practical way a new independent firm could assemble an effective management team would be to contact professional employment agencies or place advertisements in meat trade magazines and journals. Established packers generally have less difficulty recruiting management personnel because they can staff new plants by promoting from within the organization.

Some rural packers often miss an obvious opportunity in their management recruitment program by failing to emphasize significant fringe benefits of rural life, such as lower housing costs and property taxes, often shorter commuting time to and from work, and access to outdoor recreational activities for themselves and their families.

The entire management staff, including the senior cattle buyer and sales manager, must be able to work together as a team to efficiently coordinate cattle procurements, slaughter scheduling, use of labor and facilities, product inventory, merchandising, and distribution. Sound management and good labor policies are essential for maximizing a firm's profit potential.

PLANT SITES

Candidate sites can be screened by considering their potentials for meeting key location needs. The search can be narrowed by considering first the requirements that local sites might have difficulty in meeting and thereby eliminating the obviously unsuitable. Those remaining should be investigated in detail until the best site is selected. Among the most significant factors affecting that choice are—

(1) Site accessibility, including convenient connections with interstate highway systems and railroad main lines.

(2) Size, shape, and cost of the site, including costs necessary for preparation and development.

(3) Acquisition potential of land adjoining the initial site for future expansion.

(4) Land topography, including drainage conditions and flooding potentials.

(5) Soil conditions, including load-bearing characteristics.

(6) Availability and costs of utilities and municipal sewage lines at the site.

(7) Industrial zoning status of the site, existing easements, and other legal considerations.

(8) Possible objections from local residents.

(9) Adjacent land use, including present and future relative freedom from dust, industrial smoke, ashes, or other potential contaminants.

(10) Availability of fire protection and police security.

(11) Annual taxes and insurance rates for the site under consideration.

Site accessibility is important. Convenient linkups with State and interstate highway systems and railroad main lines are essential to operate packing plants efficiently. Assembling and transporting cattle to the plant are vital functions of a packer's operations. Every needless hour in transit shrinks cattle weights and packer profits. Chilled beef is a highly perishable commodity and must be distributed promptly to markets. Therefore selection of a site must be based on minimum time and costs for these procedures. The site must have frontage on a paved, well-maintained road conveniently linked to State and interstate highway systems to be accessible to over-the-road trailer trucks. This, however, does not necessarily mean that the plant should be located directly on a major highway. Traffic hazards might be created on such a highway by trucks slowing down to turn into the plant property. Potential traffic patterns should be evaluated to avoid accidents, congestion, and delays when large trucks enter or leave the site. Except for plants catering only to local markets, sites should also be as close as possible to an existing rail line so that a spur could be extended to the plant at minimum cost. Site accessibility to a railroad, however, would be less important to small and medium-sized plants if nearby piggyback shipping facilities were available.

The size, shape, and cost of the site, including any additional expenses necessary to prepare it, should be considered. Often land cost is misconstrued as the owner's asking price, when in reality the sum may be only a part of the total cost. An apparently inexpensive land tract might become costly should demolition and removal of existing buildings, filling, grading, piling, or other improvements be necessary before construction could begin. Costs associated with site clearing and preparation must be considered. If the shape of a land parcel is irregular or unusual in any way, it is important that space requirements for the proposed facilities be checked against boundary contours or other obstructions to insure that they will not interfere with or limit expansion.

Acreage requirements vary directly with planned production capacity. Approximate land needs for plants slaughtering 20, 60, and 120 head of cattle per hour, as presented in the Oklahoma study (*23*), are shown in table 9, along with overall estimates that would satisfy land requirements for landscaping, plant expansion, and an independent waste-treatment system in most regions. Space estimates in the Oklahoma study were originally planned for urban rather than rural plants and consequently reflect absolute minimum needs, with expansion considered only for increased cooler capacity. Also, land areas normally used for landscaping were not included, but some land would definitely be used for such purposes by rural packing plants. Rural packers must also consider the possibility of future overall expansion for increased slaughter capacity and a wider range of processing operations.

Although municipal sewage systems were assumed to satisfy all requirements for such services in the Oklahoma study, this assumption might prove to be impractical for many potential packing-plant sites in rural areas. For a rural plant, an independent waste-treatment system may be a necessity, and if such a system were to include lagoons, it would require additional land as well as some land for odor buffer zones. Final discharge of wastewaters by irrigation would create even greater acreage demands. Plans for such an independent sewage system would have to be carefully worked out in consultation with a sanitary engineer before a satisfactory system could be selected and acreage needs for that waste-treatment system accurately established.

The possibility of acquiring additional land next to the original site for further expansion should also be considered, whether or not the potential operators plan to expand. It is difficult to be certain of just how the beefpacking industry may change in the future or what needs for facilities could eventually develop. Meat-fabricating processes and other functions now performed by others may eventually be performed extensively at the packing-plant level and could mean substantial increases in facility needs. Failure to acquire or take options on sufficient land at the beginning might make such land procurement for future expansion

TABLE 9.—*Estimated land requirements for 3 sizes of cattle-slaughter plants*

Facility area		Requirements by plant size in kill capacity per hour		
		20 head	60 head	120 head
Packing plant	sq ft	11,761	27,821	49,622
Parking lots and dock aprons	do	10,326	26,829	53,850
Cattle corrals	do	8,800	27,800	52,300
Sewage-treatment lagoons and equipment	do	653,400	1,829,520	3,136,320
Land set aside for other functions [1]	do	404,713	1,355,030	3,241,908
Total estimated land	do	1,089,000	3,267,000	6,534,000
Do	acres	25	75	150
Possible irrigation land [2]	do	45	120	230
Total estimated land, including that for irrigation	do	70	195	380

[1] Includes land for landscaping, future plant and sewage-treatment expansion, and odor buffer zones around the property.

[2] Where sufficient land is available and climatic conditions are favorable, an alternative to sophisticated and expensive tertiary sewage treatment is discharge of treated wastewaters by irrigation. Additional acreage requirements of this magnitude would serve to reduce per acre average land costs considerably to perhaps $1,000 to $3,400 per acre depending on locality and other site location factors.

programs extremely expensive. Fortunately land is often the least expensive part of the total package. Therefore more land rather than less should be acquired when the initial purchase is made.

The land topography of the initial site and surrounding area can affect the cost and requirements for plant construction and later upkeep. Topographic maps of the area showing ground elevation and slopes should be reviewed. Where a large area is involved, an aerial survey is often the most efficient way to obtain this information if topographic maps are unavailable. The natural patterns of water runoff should be investigated to determine what drainage facilities and protection from storm floods and erosion are needed. Potential susceptibility to damage from earthquakes, tornadoes, and hurricanes should also be noted.

Soil characterisitics and underlying strata are important in planning construction. The load-bearing characteristics of the soil, subsoil conditions, and the depth to bedrock and to ground water should be analyzed and considered. Those considering the use of an independent sewage-treatment system would need to determine the soil percolation rate as well as ground-water characteristics to preclude any chance of contaminating such water resources.

The availability, dependability, and current costs of utilities, including electrical power, gas, water, and possible municipal sewer service, to the site should be thoroughly evaluated. The capacities of the local electric power system should be investigated, as well as the incidence of power failures in the past 5 years and the emergency facilities available in the event of such failure.

Planners should also assess pipeline dimensions, pressures, and flow capacities for gas and water, along with the size and flow capacity of municipal sewerlines available to the site. Current rates and other information about these services can be obtained from local suppliers of these utilities. The proposed undertaking and its special demands on their utility systems should be discussed with these local suppliers, and their advice and cooperation should be sought. If these services are not already available at the most promising sites, find out from local suppliers the possibilities, limitations, and costs of extending these utilities to these sites. The availability, dependability, and current cost of fuel oil supplies should also be determined.

The industrial zoning status of the site should be ascertained and any other legal considerations that apply. Local zoning laws and ordinances are very important in site selection. In general, it is inadvisable to locate a plant near any residential or other area set aside for possible residential expansion. Zoning problems no longer are limited to sites near municipalities, now that many counties are adopting industrial zoning laws. Injunctions against packers, processors, and renderers on public nuisance charges are not uncommon, even where existing ordinances do not specifically prohibit establishing a packing plant. As a rule-of-thumb, no anaerobic lagoons should be constructed within at least a half to 1 mile of any residence and preferably downwind, regardless of whether existing zoning laws permit such a development.

Ownership of land must be determined and validity of title to it searched to avoid legal problems. Already-existing easements for pipelines, powerlines, and future roads across the property should be checked to see whether they interfere with proposed use of the land.

Objections by local residents should be anticipated and plans should be made to avoid or reconcile them. Prior objections to packing plants have focused principally on nuisances caused by unpleasant odors, flies, dust, traffic congestion, and early morning noises.

Use of land adjacent to the site, including present and future uses, should be determined. Federal meat inspection regulations recommend that, so far as practical, adjacent land use should be reasonably free of objectionable foreign odors, dust, industrial smoke, ashes, or other potential contaminants.

Availability of fire protection and police security should be considered. What is the size in men and equipment of the local fire department? Is it volunteer or permanent? How far from the proposed site is the fire equipment based? About how much time is required to respond to an alarm? Where are the fire hydrants or other water sources that will be used if there is a fire at the site?

Similar questions should be asked about the police protection for the immediate area. What police department has jurisdiction over the site? How large is it? What is its normal workload? How frequent and how intensive are scheduled patrols in the area of the proposed site? What is the local crime level, and what estimates are there of potential increases?

Annual real estate taxes and insurance rates for the site under consideration and facilities to be built on it should be estimated. Community leaders should be asked to indicate whether they might be able to grant special tax concessions for the proposed venture. What effect might this assistance have on the firm's overall tax structure, including personal property, inventory, payroll, fuel, and other taxes?

Prospective plant sites should be investigated with the cooperation of local community leaders and the assistance of local real estate brokers. Local realtors might render further assistance later by helping to negotiate purchase of the selected site. This might include assembling land parcels if the site should involve multiple ownership.

UTILITIES AND ENVIRONMENTAL POLLUTION CONTROL

Utilities

Energy, in the form of natural gas, propane, coal, or fuel oil, and electricity must be readily available to any industrial site in sufficient quantities throughout the year with known reliability. Likewise, adequate and dependable water availability is another prime consideration for utility feasibility. Table 10 shows annual utility requirements for 20-, 60-, and 120-head-per-hour cattle-slaughter operations, including edible and inedible rendering and hide-curing activities. These estimates are based on findings developed in the Oklahoma (*23*) and California (*44*) studies, with supplemental data used to estimate additional utility needs not covered in these reports. Annual rates and charges for these services could be determined

TABLE 10.—*Estimated annual utility requirements for 3 sizes of cattle-slaughter plants*

Plant size in kill capacity per hour[1]	Gas	Electricity	Water[2]
	Cu ft	*kWh*	*Gal*
20 head	14,450,400	761,429	22,674,960
60 head	43,352,400	1,949,609	67,525,920
120 head	86,704,800	3,742,034	135,051,840

[1] Cattle-slaughtering plants operating at their rated line speeds, including inedible rendering and hide-curing operations.

[2] Equitable to sewage-capacity requirements.

by conferring with local suppliers at the time of the feasibility study. Unit costs for most utilities decline as the quantity consumed increases. This would normally result in lower average costs as production expanded, unless such economies were offset by increased per-unit needs.

With decreasing supplies of domestic oil and natural gas, which were highlighted by the oil embargo during 1973–74, the subsequent costs of energy for industrial users have increased dramatically. Therefore the evaluators should request thermodynamic engineers to recommend power systems designed to reduce plant energy consumption without detrimentally affecting projected production. Energy conservation by using high efficiency boilers and refrigeration equipment should be encouraged wherever possible. Likewise, system modifications and revisions in standard equipment to customize plant functions can enhance efficient energy use and thereby conserve energy. Also, efficient heat recovery and recyling systems are large energy savers that can reduce aggregate plant fuel requirements. For example, warm air discharged by refrigeration compressors can be utilized as a source of heat for hot water and space heating rather than being wastefully expelled outside the plant as reject heat. However, long-term energy conservation programs are dependent on plant management's attention to details of daily operating procedures, good plant maintenance, and prompt equipment replacement whenever necessary.

Consideration also should be given, if possible, to adding fuel use flexibility into any recommended plant power systems. This would enable management to switch to alternative energy sources should the availability of certain fuels become scarce or supplies curtailed. It should be noted that industrial users of natural gas will be restricted before residential users in the event of any future shortages, a consideration of merit when selecting power systems and energy sources.

According to U.S. Department of Agriculture's meat contamination regulations, a type of fuel should be used that is reasonably free of smoke, flying ash, or other potential contaminants. Where natural gas is unavailable, oil with a low sulfur content or other suitable fuel that contributes little to pollution should be considered. It is further recommended that the evaluators consult with State and Environmental Protection Agency (EPA) regional air quality officials to determine the proposed plant's status with regard to compliance with the Clean Air Act of 1970. Necessary air emission controls can add 10 percent or more to plant investment costs, particularly if both odor (rendering) and particulates (ash, smoke) are involved.

Packing plants need electricity for many purposes. Refrigeration compressors, kill-floor equipment, rendering and hide-curing equipment, utility pumps, and plant lighting use large quantities of electric power. Well-distributed good-quality artificial lighting is required when natural lighting is either not available or insufficient. Lights causing color distortion or shadows are not acceptable. Illumination in and around work areas where inspections are being made must be at least 50 foot-candles. Overall lighting intensity in other in-plant work areas should be not less than 20 foot-candles.

The major need for fuel energy in a packing plant is to heat hot water boilers. Additional heavy fuel consumption needs concern the plant's rendering activities and heat needed for nonrefrigerated work areas, offices, and welfare facilities during the winter in most localities. Heating needs for these last functions can vary as much as 20 percent from year to year solely because of weather conditions.

Water is needed in the plant mainly for washing carcasses, heads, hearts, tripe, and other edible offal and also for cleaning livestock pens, kill floors, and equipment. A constant supply of hot water, at not less than 180° F, is needed during each daily slaughtering period for these functions. Rendering and hide-curing activities also require large quantities of water. Both hot and cold water under adequate pressure must be provided in recommended areas throughout the plant.

The water supply must be able to meet official water quality standards set by the Safe Drinking Water Act of 1974 (*79*). These water quality standards, adopted by the States in June 1977, were devised by and are effectively controlled by EPA but are enforced by State water officials.

Water quality tests must be made because raw-water supplies may have to be treated, particularly if surface sources are used. Also, water quality tests should be made to determine the possible need to condition (soften) the plant's water sources, since hard water may cause scaling or corrosion to plant equipment.

Wastewater Pollution Control

The best way to dispose of effluent from a packing plant is to link up to an existing municipal sewage-treatment system. If such a publicly owned system is readily available with excess treatment capacity, use it. If no public system is available, the plant will have to develop its own system for wastewater disposal.

Sewage-treatment systems operated by municipalities generally treat organic packing-plant wastewaters at lower cost than private systems for individual plants, because they are designed to handle large quantities on a continuous basis. However, accepting packing-plant wastewater into a local public system might prove to be unfeasible depending on the extent of the community's excess treatment capacity and the slaughter-production capacity of the proposed packing plant. Conferences should be held with EPA officials and State water-pollution control authorities, as well as with local municipal sewage-treatment officials, to determine both the volume and the biochemical oxygen demand (BOD) loads or suspended solids concentrations that will be acceptable from the proposed plant's effluent discharge. BOD is a basic unit of measure used to describe the strength of sewage. It refers to the amount of oxygen required by micro-organisms in a given volume of wastewater to decompose the organic matter in it over a given time period.

This inference that use of a publicly owned treatment system is the "best way" to handle a potential packing-plant's wastewater program is in fact dependent on the extent of a municipality's excess or "surplus" treatment capacity. Nevertheless it should be pointed out that chambers of commerce and other promotion groups will provide at times the use of municipal treatment facilities and other useful services or tax relief to industry as an incentive to attract new job opportunities for their rural communities, particularly where chronic unemployment exists. Where excess municipal treatment capacity is nonexistent, costs of construction or modification and subsequent operation of such expanded municipal facilities are almost always higher than private treatment, especially where a packing plant is a substantial contributor to the system. Municipal sewer use surcharges to others may be high, and the packing plant by using the municipal system will lose tax deduction benefits associated with private investment. Furthermore, the vast majority of municipal facilities are currently overloaded and therefore "existing excess capacity" must be considered a luxury.

Another significant point is that normal packing-plant discharges of animal fats and oils (so-called hexane extractables or oil and grease) or nitrogenous pollutants (particularly ammonia) may cause a problem for a municipal system that has its own EPA NPDES (national pollution discharge elimination system) permit to be concerned about. Finally, if any Federal EPA grant monies are used to build or modify municipal plants, the industrial users are required to contribute their fair share of costs on a basis proportional to the waste load their plant discharges (*8*, *9*, *67*, *103*, *117*).

Pretreatment

Packing-plant wastewaters normally contain blood, manure, and particles of flesh and fat. Meat scraps and other particulate material can be easily screened out of plant wastewaters, which then can flow into detention tanks for gravity separation of grease. Waste materials from these processes can be salvaged. Parts can be rendered for inedible grease and the rest processed for animal feed or fertilizer. The sale of these products from recovered wastes can help defray the costs of in-plant pretreatment. Small plants may sell unprocessed grease wastes to rendering firms in the area. At this point, the wastewater effluent may or may not be acceptable for discharge into a municipal sewer depending on official local standards for BOD or suspended solids and the community's available surplus sewage-treatment capacity.

Primary Treatment

Many municipal sewer codes now have strict limits on BOD levels or suspended solids concentrations from packing plants. Further treatment may be required before the effluent is acceptable for discharge into a public sanitary sewer. Air-flotation systems that incorporate surge and retention tanks to remove additional solids materials can lower BOD levels after screening has removed part of the solids. Air flotation uses air, pH control, pressure, and chemical additives to produce a clarified effluent, which often is acceptable for discharge into municipal sewers. Additional skimmings accumulated from this further treatment also can be used for animal feed or fertilizer. Air flotation is by far the most efficient pretreatment or primary treatment system available. However, well-operated catch basins with mechanical skimmers and solids recovery are far less expensive and may be adequate.

Secondary Treatment

Where acceptable public sewage service is not available to the proposed site, the potential plant operator must plan an independent waste-treatment system that will pass State and Federal water-pollution control standards. A letter of approval from an appropriate State authority indicating that the plant's proposed waste-disposal system complies with the State's standards must be submitted to the U.S. Department of Agriculture before Federal meat inspection can commence at the plant. In the past, jurisdiction for granting such approval was vested in State health authorities, but now most State departments of health no longer have authority to certify water-pollution control facilities. Instead, this responsibility rests with State water or environmental control agencies, most of which are now separate from State health departments.

Another prerequisite for approval requires that a permit to discharge into surface waters be obtained from the Federal Environmental Protection Agency (EPA) if the plant is to be a direct discharger. This pertains to all plant construction initiated after October 1973 and requires that a new plant's waste-disposal system must comply with the EPA's new source performance standards for direct dischargers. For clarification of these requirements, see section 306 of the Federal Water Pollution Control Act of 1972 (*78*).

Besides treating plant wastewaters as previously described, the packer must install secondary and sometimes tertiary waste-treatment systems. Biological processes that are now being used as secondary treatment for meat industry wastes include anaerobic (deep) lagoons, aerobic (shallow) lagoons, the anaerobic contact process, an activated sludge process, and high-rate trickling filters. The most common and usually least expensive method of secondary treatment is the combination of anaerobic and aerobic or aerated aerobic lagoons in series.

If enough land is available at reasonable cost, a combination of anaerobic and aerobic lagoons can be used as an independent system to treat packing-plant effluent wastes economically. The acreage required for waste-stabilization lagoons depends primarily on (1) the plant's slaughter capacity as well as the various processing functions to be performed and therefore the amount and strength of effluent discharge, (2) waste-conservation practices and type of pretreatment the effluent is to receive in the plant, (3) local climate and outdoor temperatures, and (4) characteristics of the subsoil beneath the lagoons. For example, reported loadings in conventional aerobic stabilization lagoons range from 50 pounds per day per acre for treating raw wastes of packing plants in South Dakota to 214 pounds per day per acre for relatively dilute effluent wastes in Delaware. The wide difference in load capacity illustrates the effects of pretreating the raw effluent and of a warmer climate that favors activity of micro-organisms.

For purposes of acreage estimating, anaerobic-aerobic lagoon installations require a combined water surface area of between 5 and 7 acres per 100 cattle slaughtered per day in States such as Texas, Oklahoma, and Kansas. Total land area requirements, including land set aside for dikes and fencing as well as water surface area, would increase the estimated acreage requirement to 6.5–9 acres per 100 cattle slaughtered per day. (*8*, *109*) However, any attempt to determine specific acreage needs for a private sewage-treatment system without clearly defining the entire waste-disposal design and the specific area where it is to be used would only tend to confuse rather than clarify the issue. Accurate acreage data or even substantiated estimates for a particular size of packing plant in a specific area of the Nation would require consultations with qualified sanitary engineers.

The high concentrations of fats, proteins, carbohydrates, and other organic nutrients found in meatpacking wastewaters make such effluent well suited to anaerobic treatment. However, such treatment is restricted only for use as the first stage of secondary treatment. Anaerobic micro-organisms that function in the absence of dissolved oxygen break down organic wastes into intermediates, such as organic acids and alcohols. Other bacteria then convert these into such gases as methane and carbon dioxide. Unfortunately much of the organic nitrogen present is converted to ammonia. Also, sulfur compounds that are present are converted into hydrogen sulfide, which adversely affects the acidity of the effluent and creates offensive odors as well. For this reason, anaerobic lagoons have a cover of grease or straw to preclude odors from becoming objectionable and thereby deter local ordinance problems. Once an anaerobic lagoon is in operation and a good grease cover has been established, odors generally do not persist for more than 1,000 feet away.

Aerobic treatment constitutes the second stage of secondary effluent treatment. Aerobic micro-organisms that thrive only in the presence of oxygen are capable of reducing almost all organic matter from meatpacking waste into the final end products of carbon dioxide and water if a sufficient supply of oxygen is available so that these bacteria can perform their function of feeding on organic wastes as their food source. Oxygen is supplied in aerobic lagoons through natural wave action. These shallow lagoons require large water surface areas, but such land requirements can be reduced by supplementing natural aeration through the use of mechanical devices. Aerated aerobic lagoons utilize fixed turbine aerators, floating propeller aerators, or other systems to supply large quantities of dissolved oxygen to the wastewaters.

The anaerobic contact process involves placing the effluent first into a settling basin to remove solids and grease and then transferring it into another detention tank, where the wastewaters are thoroughly mixed and heated. After the wastewater leaves this digester, it is discharged into a vacuum degasifier to remove the gases formed by action of certain bacteria and then transferred into a gravity sludge separation tank. One of the gases given off is methane, which is salvaged and burned in a boiler to heat incoming wastewaters. The anaerobic contact system requires a substantial amount of expensive equipment as opposed to requirements for anaerobic lagoons, but it significantly reduces detention time and requires much less space. The effluent from this process usually flows into an aerobic treatment system, such as oxidation ponds or an activated sludge plant, for further treatment.

The activated sludge process is much more capital intensive than aerobic lagoon systems, but it also reduces land acreage requirements to a considerable degree, particularly for large plants. This waste-treatment system uses aerobic micro-organisms to feed on the pollutant materials in large aerated tanks. Organisms are provided with an optimum environment for reproduction. With plenty of air for respiration and a constant food supply of dissolved and colloidal organic pollutants, the organisms increase rapidly and accelerate the rate of biological oxidation. As the organisms build up in numbers, they form a sludge. The relatively clean wastewater remaining is separated in a settling tank, leaving behind huge amounts of aerobic organisms. The less viable organisms that make up the sludge are discarded, and a portion of the organisms, referred to as "activated sludge," is returned to be added to new incoming wastewaters to continue the biological process.

Trickling filter systems promote biochemical oxidation by permitting wastewaters to trickle down through a bed of stones or synthetic media that have a large surface area. Aerobic micro-organisms, which are naturally in all organic wastewaters, adhere to the stone surfaces and feed on the suspended and dissolved organic pollutants, and thus cleanse the wastewater flow.

The rotating biological contactor is another aerobic tank-type process that can be used where land is limited. This system features closely spaced, rotating, biological surface discs. These large-diameter plastic discs are mounted together on a common horizontal shaft and rotated into and out of the wastewaters. Aerobic organisms present in the wastewaters adhere to the disc surfaces and begin to rapidly multiply through the enhanced availability of oxygen as the discs move out of the wastewaters and into the air. Spent organisms slough off the discs and are removed in a clarifying operation that follows the rotating disc treatment. The rotating disc devices are arranged in a series of stages to increase the effectiveness of the overall treatment. This European system is said to be capable of doubling the capacities of most organic secondary treatment plants housed in relatively confined areas.

Tertiary Treatment

Wastewater effluents properly processed through efficient secondary treatment systems are generally 80 to 97 percent free of their original polluting materials. Depending on the level of BOD reduction to be achieved by the secondary treatment and State water-control requirements for its removal, a tertiary treatment may be required. Highly controlled effluent polishing ponds can be used for this purpose. Treated effluent from this final clarifier then flows into a chlorine detention pond or tank and afterward is discharged into surface receiving waters.

Filtration systems utilizing sand or other mineral fines media also are devices that when properly managed and maintained constitute tertiary treatment. Effluent is removed in a slow sand filter by underdrainage, although some biological activity occurs in the top inch or two of media. A rapid sand-filter system functions basically in a manner similar to the slow filter system, except that the effluent is placed under pressure. Whereas the slow sand filter removes solids primarily at the upper surface area of the filtering system, the rapid sand filter operating under pressure permits deeper penetration of suspended solids into the sand bed. This allows solids removal to occur through a greater cross section of the bed and thus substantially reduces the requirements of the bed's surface area. Chlorination, both before and after sand filtering, is desirable to eliminate potential odor problems and slimes that may cause clogging in the initial filtration process (*103*).

Nutrient controls for the removal of ammonia also constitute tertiary treatment. Such final clarifier techniques as nitrification-denitrification or ammonia stripping are used for this purpose. These sophisticated treatment systems remove nitrogen that has been generated as ammonia during anaerobic secondary treatment. Nitrogen as well as other nutrients such as phosphorus promote heavy algae blooms in receiving waters during the warm summer months. Phosphorus can be eliminated through a chemical precipitation process.

Tertiary treatment systems have a high initial cost as well as high operating and maintenance costs. Where sufficient land is available and climatic conditions are favorable, an alternative to such sophisticated and expensive systems is the discharge of treated wastewaters by irrigation. The three basic methods for ultimate disposal of treated wastewaters through this technique consist of spray irrigation, overland runoff, and rapid infiltration. Besides costing significantly less to install and operate, the concept holds great potential economic benefits for crop irrigation or similar activities. However, under this system the waste loading in the effluent is limited by the tolerance of crops grown, soil conditions, terrain features of the land being used, and possible vermin or odor problems.

FACILITY PLANNING AND PROJECTED PLANT INCOME

If all the preliminary facts investigated favor establishing the proposed plant, the next step is to determine whether it can be operated profitably. The plant's profit potential can be estimated by comparing probable buying, operating, and distributing expenses with probable sales revenues. By using budgeting techniques to estimate these inputs, a projected income statement can be prepared to determine the economic feasibility of the venture.

Since capital investments in land and facilities represent part of the plant's operating expenses, these costs, like the others, must be estimated before a projected income statement can be prepared. Such an estimate can only be synthesized by first determining the kinds and capacities of integral processes that are expected to be part of the plant's operations.

Planning Facilities

Various types of on-the-rail slaughter-dressing systems can be used depending on the hourly kill capacity of the proposed facility. Small to medium-sized plants that kill up to about 40 head per hour can use either a gravity-flow system or an intermittent-power conveyor system. In the gravity system, rail height declines as the carcasses move from the initial bleeding area to other work stations along the processing line. Rail stops halt the carcass at each work station until a specific operation has been performed. The carcasses move along the plant's sloped rail processing line by the force of gravity rather than by mechanical power.

In the intermittent-power system, the rail is parallel to the kill floor. A power-driven chain moves the carcasses from one work station to the next at intermittent time intervals. Both gravity and intermittent-power systems use paunch trucks to handle viscera removed from the carcasses.

Plants with kills of 40 or more head per hour generally use continuous-power conveyors. With this system, a powered overhead conveyor moves the animal carcasses along the processing line without stopping but at adjustable speeds. A moving-top viscera table is synchronized in speed with the powered overhead chain conveyor. The viscera removed from the moving carcasses onto the moving table below are inspected and then routed to appropriate workup areas. Splitting, scribing, trimming, washing, scaling, and shrouding operations are basically the same for all systems.

One of the major benefits of on-the-rail slaughtering is that less bending and nonproductive movement is required of workers. Adjustable work platforms are provided at various work stations along the processing line. The system eliminates the need for labor to move carcasses about the kill floor. Another advantage is that slaughter productivity can often be increased significantly without increasing the size of the kill floor. This can be done by rearranging work areas, using different types and amounts of equipment, and increasing the plant's labor force. Those plants equipped with continuous-power conveyors can gain productivity by increasing the plant's chain speed, rebalancing the crew, and adding more labor inputs. Further productivity is possible by increasing the number of work shifts per day provided enough cooler space is available for the additional production.

Conventional bed-type kill systems popular in the 1940's are no longer being installed in commercial slaughter plants. However, many plants operating today still use this kill method. In the bed system, carcasses are lowered from the bleeding rail to cradlelike metal beds located about 6 to 8 inches off the kill floor. Workers must stoop to perform several major operations, such as removing the animals' legs, legging and siding the hide, and splitting the brisket bone. Other laborious tasks are then performed before the carcasses are shipped to the coolers. The increased labor efficiency of the rail system over the bed system has caused it to be adopted for virtually all new plant construction.

A detailed discussion of on-the-rail slaughter operations as well as the older bed-type system can be found in an engineering orientation study of the meatpacking industry by Bonem (*9*). For a description of an effective overhead carrousel-type gravity-flow dressing system for kill rates up to 35 head per hour, see the report by Erickson (*18*).

The shift from conventional bed-type kill systems to on-the-rail dressing systems, along with other innovations, has had a significant impact on packing-plant efficiency. Labor productivity or output per man-hour, as shown in table 11, increased 125 percent in the meatpacking industry from 1947 to 1975 (*88*). In other words, less than half as many man-hours were required per unit of productive output in 1975 as in 1947. The technological improvements most significant in this increase, besides on-the-rail dressing, were the introduction of improved stunning devices, hydraulic hide strippers, and various powered handtools. Well-designed single-story buildings with more efficient product-flow patterns also contributed to these gains. Further increases in labor productivity will probably be needed because of the industry's low profit margin and the relatively strong bargaining position of retailers. Since the 1950's, corporate and voluntary retail chains have become an important factor in the market, whereas packing-industry influence has declined. Decentralization of ownership and the decreased size of packing plants have been major factors contributing to this change.

Similarly, planning decisions must be made concerning the types, sizes, and quantities of equipment to be used in other affiliated plant functions, such as in the inedible rendering department. Should a batch system or a continuous rendering system be employed? Or might it be more practical and economical to sell the proposed plant's inedible offal fresh to rendering specialists rather than attempt to process it at the plant? Should a blood dryer be installed? If so, what type and size?

These are questions that must be answered before even a basic layout can be developed. Typically the answers to all such questions about the plant's operations are predicated on the plant's proposed kill capacity. As an example, various rendering systems require minimal raw-material volume to operate profitably. The plant's estimated inedible offal production must be matched against these minimal rendering volume requirements to determine whether the installation of such equipment will be economically feasible.

TABLE 11.—*Labor productivity in meatpacking industry in the United States, 1947–75*

[Index 1967 = 100]

Year	Indexes of labor productivity in meatpacking[1]		
	Productive output[2]	Man-hours[3]	Output per man-hour[4]
1947	61	118	52
1948	56	112	49
1949	58	116	49
1950	59	116	51
1951	58	119	49
1952	61	121	50
1953	66	[5]118	[5]55
1954	67	117	57
1955	73	119	61
1956	78	124	63
1957	76	117	65
1958	73	[6]109	[6]67
1959	77	109	71
1960	81	108	75
1961	82	104	78
1962	83	102	81
1963	87	101	86
1964[7]	94	108	87
1965	91	101	91
1966	96	99	97
1967	100	100	100
1968	103	98	105
1969	103	97	106
1970	106	97	108
1971	110	96	115
1972	112	95	118
1973	101	90	113
1974	110	92	119
1975	106	91	117

[1] Includes both meatpacking plants and establishments specializing in prepared meat products.

[2] Output estimates are based on value-added indexes published by the Bureau of the Census and projected for noncensus years by physical output data published by the USDA.

[3] Man-hour estimates for 1947–70 are based on data published by the Bureau of the Census. Estimates for 1971–75 were interpolated from employment statistics published by the Bureau of Labor Statistics.

[4] Output-per-man-hour estimates are computed from unrounded indexes of man-hours worked by all employees and factory output.

[5] The Bureau of the Census revised the sampling plan and sample universe in the annual survey of manufacturers beginning in 1953. Thus data for 1953 and later years are not strictly comparable with those for earlier years.

[6] Data cover Alaska and Hawaii starting with 1958. Data after 1958 have been made comparable with those for earlier years.

[7] Data for 1964–75 are preliminary.

First, factors to convert slaughter-animal units into inedible raw-material volumes must be known. On the average, a 1,000-pound steer will yield about 50 pounds of liquid blood and about 125 pounds of inedible offal, such as fats, intestinal visera, and bones. Therefore since the minimal raw-material needs for a one-cooker batch system are about 3,750 pounds per hour, or about 30,000 pounds per day, the effective kill capacity of the proposed plant must be 30 head per hour or better to warrant the installation of such a system. Increasing the number of cookers in the system will, of course, increase the handling capability of the system's total operation.

Normally the minimal raw-material needs for a continuous rendering system are about 6,250 pounds per hour, or about 50,000 pounds per day. However, most equipment manufacturers recommend that this system be operated on at least a 16-hour-a-day basis rather than on an 8-hour shift basis. This would boost the daily minimal raw-material requirement to about 100,000 pounds, which would translate into a 100-head-per-hour kill operation. Since both systems are highly automated, overtime labor requirements for rendering departments are generally immaterial considerations.

Once the slaughter capacity of the proposed packing plant and the extent of its affiliated functions and operations have been decided, an overall layout should be designed to meet these specific needs efficiently. A well-planned kill floor can mean the difference between making a profit or taking a loss on each animal slaughtered. Therefore the first effort should be to make the proposed kill-floor layout the most effective and efficient possible for the slaughter capacity planned. Other operations should be planned in conjunction with the kill floor to provide optimum product-flow patterns. The building should then be planned around the plant's overall interior floor plan. Figures 7–9 illustrate cattle kill-floor layouts that meet Federal inspection requirements for 20-, 60-, and 120-head-per-hour operations.

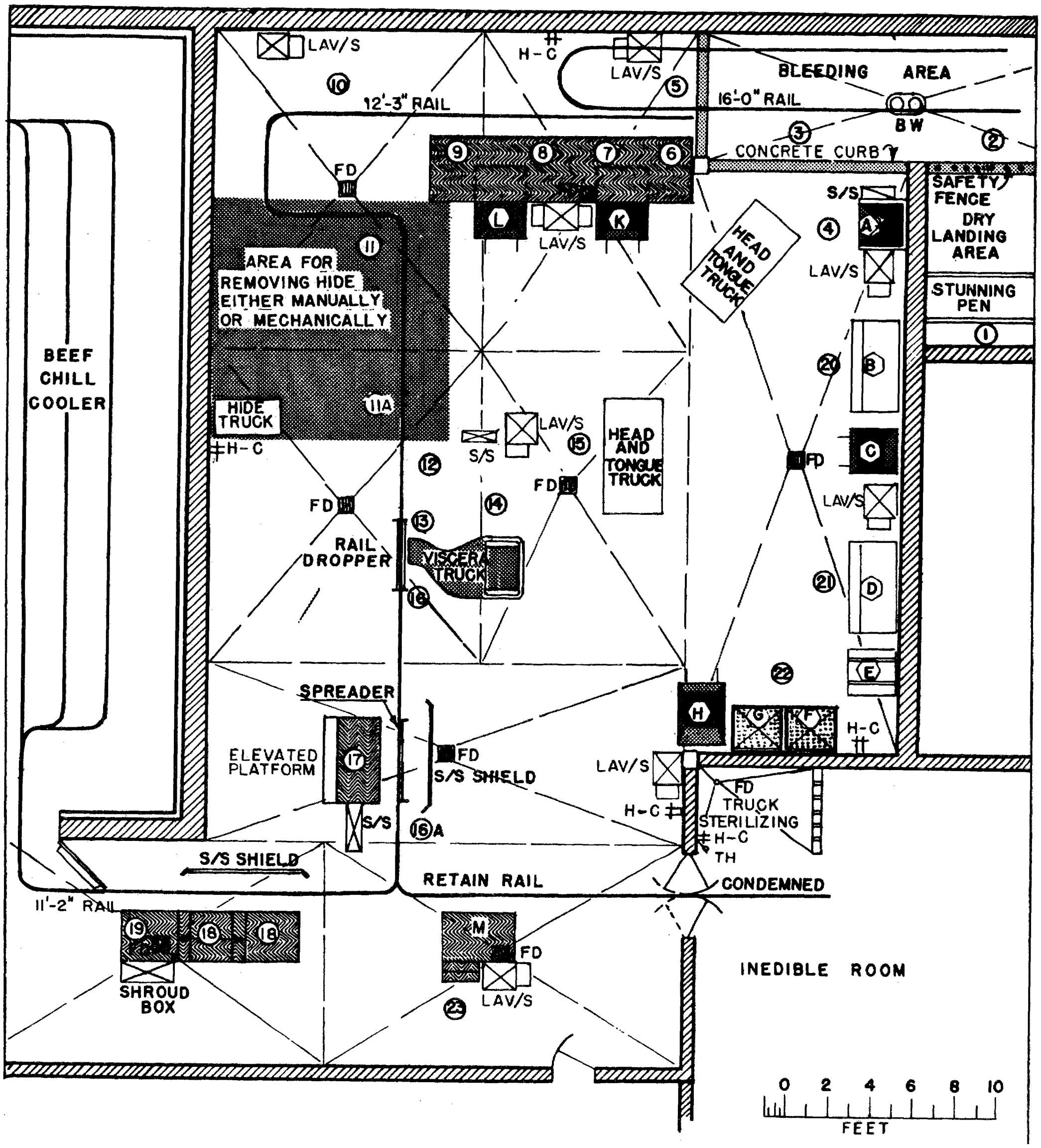
Although it is prudent to design the facility to operate at full capacity rather than provide excessive costly space, the possibility of future plant enlargement must be considered should a dependable, increased supply of cattle become available to support plant expansion. Such expansion plans must be considered during the initial stages of layout development so that later extensions will not be haphazard, inefficient, or unduly costly to construct.

Plant design and projected expansion programs must be based on the assumption that the operator will be able to compete effectively in the market. Normally this means that the proposed plant must be able to keep its production costs the same as or lower than those of its competitors.

The facility and equipment components discussed thus far do not include facilities for carcass-breaking and boxing operations, which are becoming increasingly common in new cattle-slaughter plants. Preparing packaged primal or "block-ready"cuts at the packing-plant level bypasses many problems of handling inefficiencies, shrinkage, and perishability that have been associated with traditional methods of transporting meat in carcass form. Prospective operators planning to slaughter grain-fed cattle should definitely consider establishing a boxed-beef operation. Those planning a cow-slaughter plant might consider adding facilities to bone carcasses and further process meat derived from cull-cattle sources. This could include installing a commercial bologna kitchen to manufacture luncheon meats, an automated frankfurter-manufacturing system, or similar processed-meat facilities.

In any event, new plant layouts should be designed so that such fabricating, boxing, boning, and processing activities can be integrated into the plant's operation in the future without sacrificing the efficient product flow and overall productivity originally built into the slaughtering facility.

For purposes of estimating construction and equipment costs, the evaluating team's engineer or packing-plant equipment manufacturers can prepare preliminary layouts of the proposed facilities. However, the Food Safety and Quality Service of the U.S. Department of Agriculture, which administers Federal meat inspection, recommends that only licensed architects, familiar with all inspection and sanitation requirements, prepare the final drawings and specifications for Department of Agriculture approval for Federal meat inspection. To



KEY TO EQUIPMENT

A- HEAD FLUSHING BOOTH
B- HEAD TRIM TABLE
C- HEAD MEAT TRUCK
D- PLUCK TABLE
E- OFFAL TRUCK
F- FAT RECEIVING TABLE
G- FAT WASHING TABLE
H- FAT TRUCK
K- TRUCK FOR FEET
L- UDDER AND PIZZLE TRUCK
M- INSPECTION PLATFORM
BW - BLOOD AND WATER DRAIN
FD - FLOOR DRAIN
H-C - HOT AND COLD WATER OUTLET
LAV/S - LAVATORY AND KNIFE STERILIZER
S/S - SAW STERILIZER
TH - THERMOMETER

KEY TO OPERATIONS

1- DRIVE AND STUN
2- SHACKLE, HOIST, AND STICK
3- SKIN HEAD AND DEHORN
4- FLUSH HEAD AND REMOVE TONGUE
5- REMOVE FRONT FEET
6- SKIN FIRST HINDLEG AND TRANSFER
7- SKIN SECOND HINDLEG
8- REMOVE UDDER AND PIZZLE
9- RIM OVER
10- CLEAR SHOULDERS
11- REMOVE HIDE AND TRIM GRUBS
11A- REMOVE HIDE AND DROP BUNG
12- SAW BRISKET
13- EVISCERATE
14- INSPECT VISCERA
15- INSPECT HEAD AND TONGUE
16- HIGH RAIL INSPECTION
16A- LOW RAIL INSPECTION
17- SPLIT AND FINAL TRIM
18- HIGH AND LOW WASH
19- SHROUD
20- TRIM HEAD
21- SEPARATE AND WASH PLUCKS
22- WASH FAT
23- RETAINED CARCASS INSPECTION

FIGURE 7.—Sample layout of on-the-rail kill-floor facilities meeting Federal inspection requirements for a plant slaughtering 20 head of cattle per hour.

KEY TO OPERATIONS

1 - DRIVE AND STUN
2 - SHACKLE, STICK, AND SCALP
3 - ROD AND TIE WEASAND, REMOVE HEAD
4 - DEHORN, FLUSH HEAD, AND REMOVE TONGUE
5 - SKIN AND BREAK FIRST HINDLEG AND TRANSFER
6 - BUTT, SKIN, AND BREAK SECOND HINDLEG
7 - BUTT, INSERT SECOND TROLLEY, AND HANG OFF
8 - REMOVE UDDER AND PIZZLE, SPLIT AITCHBONE
9 - SKIN AND BREAK FRONT FEET, RIM BRISKET
10 - CLEAR SHANK AND NECK, SAW BRISKET
11 - RUMP, PULL TAIL, TIE, AND DROP BUNG
12 - REMOVE HIDE, TRIM GRUBS ON MEDIAN LINE
13 - EVISCERATE
14 - SPLIT
15 - TRIM BRUISES
16 - HIGH AND LOW WASH
17 - SHROUD
18 - WORK UP HEAD
19 - REMOVE PASSED VISCERA
20 - WORK UP PLUCKS
21 - TRIM, OPEN, AND DUMP PAUNCH
22 - WASH AND TRIM TRIPE

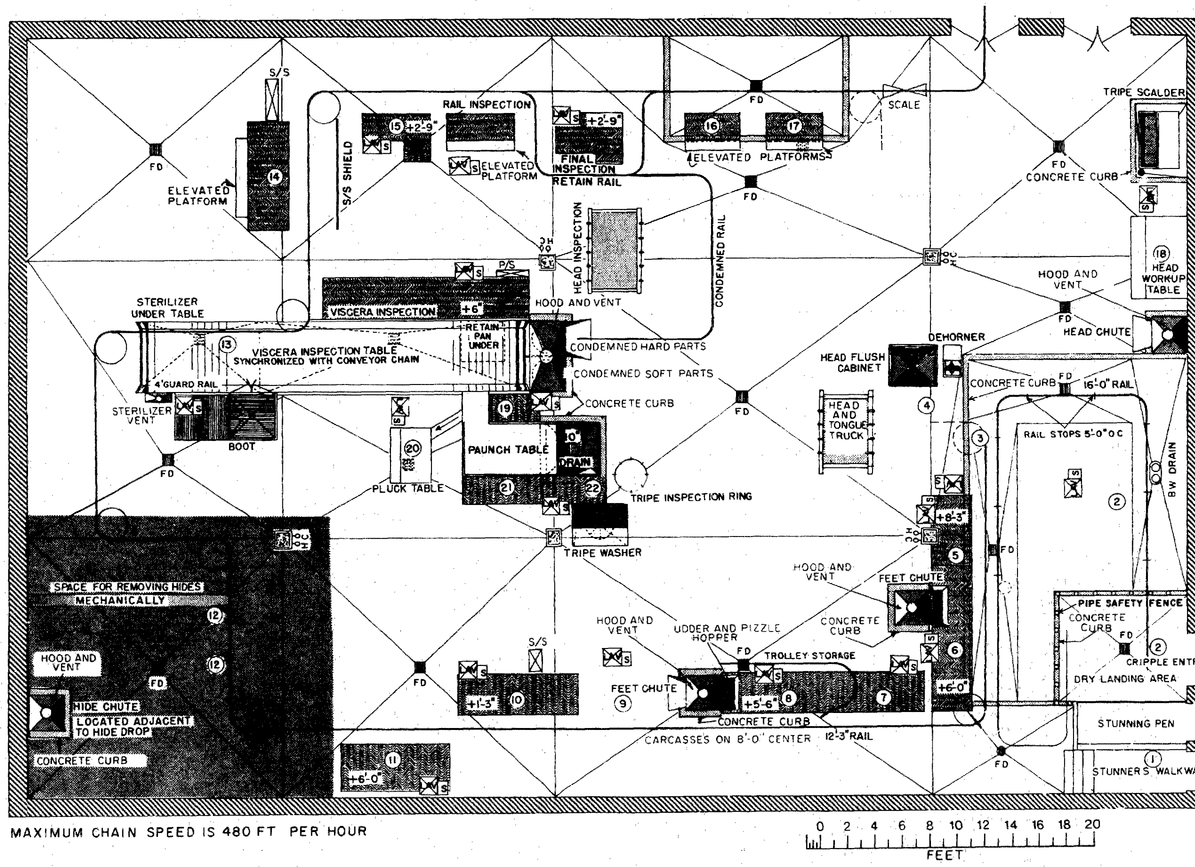


FIGURE 8.—Sample layout of on-the-rail kill-floor facilities meeting Federal inspection requirements for a plant slaughtering 60 head of cattle per hour.

KEY TO OPERATIONS

1 - STUN
2 - SHACKLE
3 - STICK AND SCALP
4 - SKIN HEAD
5 - SKIN HEAD
6 - SKIN FIRST HINDLEG AND SAW OFF
7 - BUTT, INSERT FIRST TROLLEY
8 - REMOVE SHACKLE, SKIN, AND REMOVE SECOND HINDLEG
9 - BUTT, INSERT SECOND TROLLEY
10 - TAG, CUT OFF HEAD, AND DEHORN
11 - TRIM AND FLUSH HEAD
12 - PLACE HEAD ON CONVEYOR, REMOVE TONGUE AND GLANDS, HANG TONGUE ON HOOK
13 - SKIN AND BREAK FRONT FEET
14 - SKIN AND BREAK FRONT FEET
15 - REMOVE UDDER AND PIZZLE, SPLIT AITCHBONE
16 - CLEAR CROTCH AND FLANK
17 - CLEAR CROTCH AND FLANK
18 - LOW OPEN AND RIM BRISKET
19 - LOW OPEN AND RIM BRISKET
20 - CLEAR RUMP
21 - RUMP AND DROP BUNG
22 - TIE BUNG AND PULL TAIL
23 - CLEAR ROSETTE, SHOULDER, AND NECK
24 - CLEAR ROSETTE, SHOULDER, AND NECK
25 - SAW BRISKET
26 - PULL HIDE
27 - PULL HIDE
28 - PULL HIDE
29 - TRIM GRUBS
30 - EVISCERATE
31 - EVISCERATE
32 - SAW RUMP AND LOIN
33 - SAW BACK AND NECK
34 - TRIM BRUISES
35 - REMOVE PASSED VISCERA
36 - REWASH, CUT OFF TAIL
37 - SCALE, SCRIBE, AND TAG
38 - HIGH SHROUD
39 - HIGH SHROUD
40 - LOW SHROUD
41 - LOW SHROUD
42 - PUSH CARCASS INTO COOLER
43 - WORK UP HEAD
44 - WORK UP HEAD
45 - TRIM PAUNCH
46 - TRIM PAUNCH
47 - OPEN AND DUMP PAUNCH
48 - OPEN AND DUMP PAUNCH
49 - WASH AND TRIM TRIPE
50 - WASH AND TRIM TRIPE
51 - ROD AND TIE WEASAND

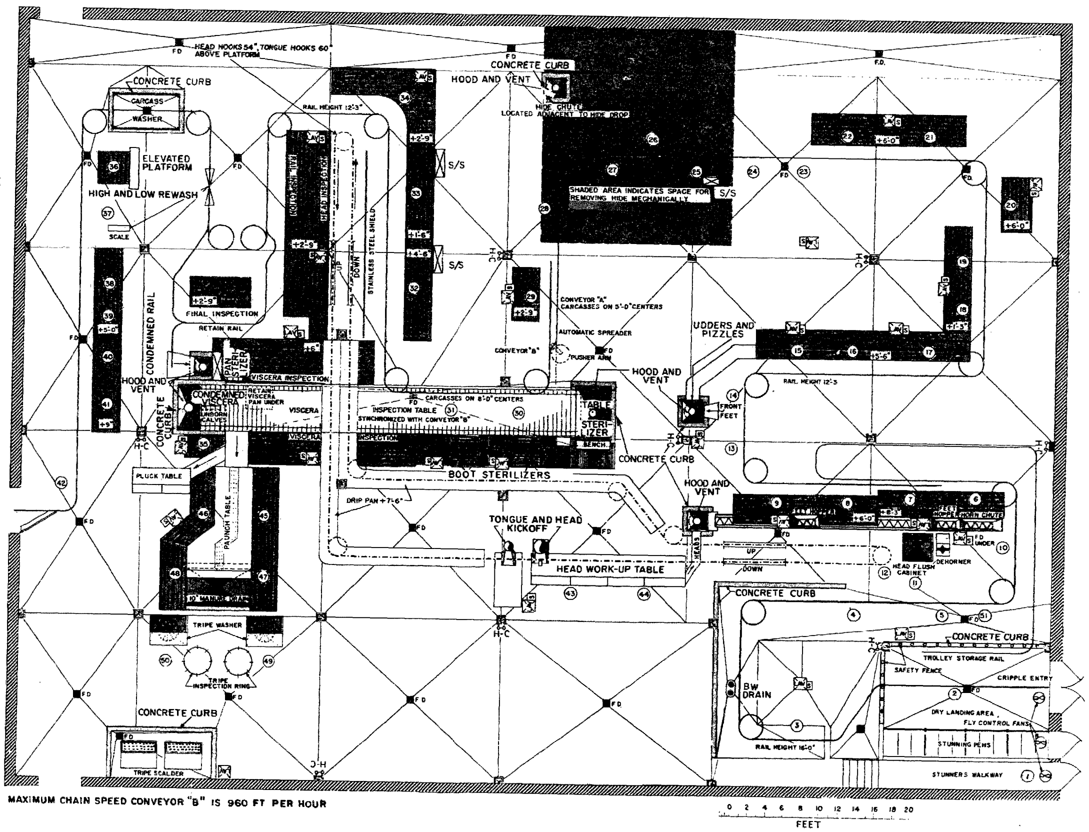


FIGURE 9.—Sample layout of on-the-rail kill-floor facilities meeting Federal inspection requirements for a plant slaughtering 120 head of cattle per hour.

avoid possible costly changes, the Department further recommends that no construction should begin until these drawings and specifications have been approved.

Detailed requirements and specifications for facilities to meet Federal meat inspection approval can be obtained from the U.S. Department of Agriculture (*81*). Some key considerations in planning and building beefpacking plants are as follows:

CHECKLIST FOR PLANNING, DESIGNING, AND CONSTRUCTING CATTLE-SLAUGHTER PLANTS

I. Basic Facility Planning Criteria

1. Determine hourly slaughter capacity, type of on-the-rail system to be employed, and space allocation for the kill floor.
2. Determine scope, capacities, and space allocations of all supporting and complementary plant operations, including minimum chill-cooler and sales-cooler storage capacities.
   a. Type of rendering system to be employed, volumes to be handled, and storage capacities.
   b. Type of hide-curing or processing system to be employed, volumes to be handled, and storage capacities.
   c. Types of integrated meat-fabricating systems to be employed, volumes to be handled, and storage capacities—such as primal breaking and boxing operations; hotel, restaurant, and institutional portion-controlled operations; precooked convenience-food manufacturing; processed-meat manufacturing; pet-food manufacturing, etc.
3. Consider rail versus truck transportation for receiving and distributing products, as well as volumes to be handled.
   a. Dock heights and truck-loading spaces.
   b. Rail-siding height and loading spaces.
4. Determine type of and total capacity requirements for the central power plant; electrical, heating, and plumbing system requirements; and maintenance facility requirements.
5. Determine type of refrigeration system to be employed, aggregate refrigeration requirements, and insulation needs for various cooler and freezer facilities.
6. Determine materials-handling systems to be employed.
7. Determine capacities of miscellaneous areas, such as dry storage, equipment cleanup, and laundry rooms.
8. Determine capacities of employee welfare and cafeteria areas and office space needs, including facilities for Federal or State inspection personnel.
9. Determine capacities of supporting buildings and structures, such as a scale house, unloading chutes, corrals, garages, and repair shops.
10. Determine capacities of parking facilities, dock aprons; provide ample space for truck maneuvering, as well as ample space for a rail spur and road accesses.
11. Determine whether sewage needs can be met by municipal sewage service or whether an independent sewage-treatment system will be required.
    a. Type and capacity of effluent pretreatment facilities within the plant.
    b. Type and capacity of independent sewage system, with daily loading factors for lagoons, etc.
    c. Type, size, and capacity of storm sewers.
    d. Necessary acreage requirements to satisfy an independent sewage-treatment system.
12. Determine total land requirements to house all proposed facilities and provide for all associated plant land needs.

a. Include an ample land allowance for future plant expansion.
b. Include ample space for landscaping.
c. Include ample land for transportation access, parking facilities, etc.
d. If necessary, include ample land for an independent sewage-treatment system as well as some land for odor buffer zones.

II. Plant Layout Design

1. Analyze and evaluate data to develop layout with equipment positioning that will provide optimum operating efficiency for plant's kill floor at rated kill capacity.
   a. Develop similar layouts for supporting operations.
   b. Coordinate all layouts for smooth and efficient product flow.
2. Design for projected expansion in kill capacity without structural alterations to kill floor.
   a. Anticipate and plan for additional cooler space required.
   b. Check to guarantee continued efficiency of product-flow patterns.
3. Plan for future projected expansion in kill capacity requiring structural alterations to kill floor but at lowest cost.
   a. Plan for similar expansion of coolers and other supporting areas at lowest cost.
   b. Doublecheck product-flow patterns.
4. Provide inspection facilities to meet Federal or State requirements.
5. Analyze and evaluate data to develop overall layout that will coordinate all other work areas and processing equipment to provide optimum product-flow patterns throughout the plant, including any complementary operations planned.
   a. Provide balance to coordinate raw-materials handling with processing rates, inventory storage cycles, etc., throughout the plant.
   b. Review layouts to identify and eliminate all potential bottlenecks, backtracking problems, excessive or unnecessary handling procedures, and any other conditions that would be disruptive to a future plant's productivity potential.
   c. Modify plans, if necessary.
6. Provide layouts with interior flexibility as well as with a well-balanced plan for projected plant expansion of all complementary operations at lowest cost.
7. Anticipate and plan for any additional meat-fabricating or processing functions that might be installed at some future date without disrupting the efficiencies of the facility's initial product-flow patterns.
8. Provide for efficient cleaning and low cost housekeeping maintenance.
9. Develop layout arrangements for all supporting buildings and structures to handle specified volumes of various commodities being received, processed, and distributed with least traffic conflict.
   a. Consider best arrangement and location of rail docks, rail spur or spurs, and switches.
   b. Provide ample rail space for full and empty cars.
   c. Consider best arrangement and location for access roads, docks, dock aprons, convenient parking facilities, etc.
   d. Where applicable, provide nonconflicting driveway access for "drive-thru" traffic patterns of truck and rail movement.

III. Building and Sanitation Specifications

1. Determine all building codes that apply to plant construction, including structural, piping, boiler, electrical, and environmental. Establish construction specifications and

standards that meet or exceed these building code requirements.
   a. Provide construction standards that offer best insurance rates for fire and security protection that added building costs can clearly justify.
2. Check on building restrictions of all government agencies, including city, county, and State.
   a. Distance of buildings from property line.
   b. Position of buildings on site with reference to access roads and property boundaries.
   c. Building height restrictions, if any.
   d. Fire and security protection, etc.
   e. All other zoning ordinances.
3. Determine necessary floor load-bearing requirements for various departments, lighting intensity, etc.
4. Check USDA Agriculture Handbook 191 for Federal meat inspection regulations to insure that all facility specifications meet Federal or State sanitary inspection standards. Some brief examples are—
   a. Plant drainage, number of inlets per square feet of floorspace, sanitary drainage lines, traps and vents on lines, etc.
   b. Plant waste disposal, catch basins, acceptance of plant waste system, etc.
   c. Plant construction, materials, floors, interior walls, ceilings, window ledges, door widths, pest control, lighting, ventilation, refrigeration, etc.
   d. Meat rail heights from floors, meat rail distances from walls, posts, and work tables, etc.
   e. Hot and cold water accessibility; minimum hot water temperature, which directly affects the heating system's requirements.
5. Provide for advanced quality control measures to reduce product perishability.
6. Arrange for satisfactory public utility connections, including water to meet EPA's standards.
7. Plan a satisfactory sewage-disposal system and all pretreatment facilities needed to meet State health department specifications.
8. Determine type of construction and construction materials to be used.
   a. Footings, foundations, and substructure.
   b. Overall superstructure, including selective placement of interior supporting columns to prevent disruption of product flow.
   c. Framing, including roofing, flashings, siding, etc.
   d. Interior finishes.
      (1) Floors, walls, ceilings, doors, windows, hardware finish, etc.
      (2) Insulation, cooler and freezer doors, overhead meat rail structure, scales, etc.
      (3) Dock air seals, dock doors, dock levelers, etc.
9. Determine type, quality, and capacity requirements of mechanical inputs to be installed.
   a. Plumbing, water-supply system.
   b. Heating system.
   c. Ventilating, air-conditioning, and refrigeration systems.
   d. Fire protection sprinkler system.
   e. Controls and instrumentation.
10. Determine voltage needs and type of electrical enclosure systems required by local, county, and State codes.
   a. Distribution system.
   b. Lighting.
   c. Communication.
   d. Power equipment.
11. Provide overall architectural design with an attractive appearance. Attempt to keep the exterior structure symmetrical and compact to reduce building costs.
   a. Maintain design so that support buildings and other structures

are harmonious and in keeping with central structure.
b. Establish specifications for security fencing around grounds.

IV. Plant Equipment Requirements

1. Check to be sure all processing equipment selected is USDA approved. Some brief requirements for such equipment are—
    a. Made of acceptable materials, such as stainless steel.
    b. Designed and constructed to prevent contamination of products processed.
    c. Demountable and accessible for easy cleaning and inspection.
2. Select processing equipment to be installed based on productivity demands previously determined. Check manufacturer's specifications.
    a. Type, quality, and rated productive capacity specifications.
    b. Initial cost plus delivery and installation charges.
    c. Proved ability to perform efficiently.
    d. Ability to combine simplicity with reliability and low maintenance requirements.
    e. Good, reliable quality control features.
    f. Some flexibility in volume handling capability.
3. Select materials-handling equipment based on similar criteria as above.

V. Employee Safety Features

1. Check with the Occupational Safety and Health Administration (OSHA) to insure that building specifications comply with all Federal safety and health regulations.
2. Provide built-in safety features to eliminate potential accident hazards.
    a. Specify all floor surfaces have nonslip finishes to help prevent falls. All grating should be serrated.
    b. Protect all shafts, floor openings, ramps, etc.
    c. Protect all moving parts on machinery.
    d. Eliminate tripping hazards and potential icing conditions on floors.
    e. Provide handrails on both sides of stairs.
    f. Provide adequate number of fire exits and specify that they be clearly labeled and illuminated.
    g. Eliminate low headroom areas and sharp corners.
    h. Use plastic or tempered-wire glass in vulnerable areas.
    i. Specify insulation on all hot lines, vats, etc., to help prevent accidental burns.
    j. Minimize employee exposure to potential breaks in refrigeration, electrical, fuel, and other utility lines. Color code to identify.
    k. Specify separation of foot and forklift-truck traffic.
3. Provide a good working atmosphere for plant's labor force, including lighting, heating, filtered air ventilation, and air-conditioning where applicable. Specify interior color decor that helps avoid employee depression and also interior equipment with low noise levels. Comply with USDA and OSHA welfare and restroom requirements.

VI. Facility Blueprints

1. Have final architectural drawings and specifications prepared, including a plot plan, that will meet USDA or State meat inspection approval.
    a. Include detailed drawings of all building specifications and floor plans, showing equipment positioning, floor drains, and floors sloped to these drains.
    b. All rooms and interior areas must be clearly labeled and distances between equipment and walls, column posts, etc., clearly indicated.

2. Have detailed drawings and specifications made for the refrigeration, electrical, heating, plumbing, and sewage-disposal systems.
   a. Include detailed drawings and specifications of independent sewage-treatment system, if any.
3. Have details in the plot plan include all buildings, rail sidings, access roads and parking areas, rainwater catch basins, water wells, storage tanks, any sewage-treatment facilities, etc.
   a. Include drawings indicating land topography and drainage.
   b. Include soil-boring results.

VII. Approval of Blueprints and Utilities

1. Submit final drawings and specifications to future plant operators for approval.
2. Submit prepared drawings and specifications to proper State authorities for certification.
   a. Obtain State health certificate that plant's water supply meets EPA's standards for drinking water.
   b. Obtain State health certificate that the plant's sewage-treatment systems meet all State pollution-control requirements.
3. After the plant's water supply and sewage-treatment systems have been approved, submit prepared facility drawings and specifications, plot plan, and letters of certification for water and sewage to the USDA or State meat inspection service for approval.

VIII. Construction of Facilities

1. Arrange for plant construction and equipment installation to begin only after USDA or State meat inspection approval has been granted.
2. Review all legal aspects connected with project.
   a. Review all local and State ordinances.
   b. Review land title, site survey abstracts, assessments if any, leases if any, contracts, agreements, etc.
3. Determine whether construction contract will be awarded as a turnkey project or whether contracts will be let to contractor and subcontractor bids.
   a. Let out bid contract package or subcontract bids.
   b. Award contract or contracts.
   c. Work out method of financing.
   d. Set up a workable construction timetable.
4. Obtain a building permit.
5. Have site put in condition to build and begin excavation and site work.
6. Arrange to obtain various building inspection approvals at various stages of development.

IX. Postconstruction Arrangements

1. Have land graded, necessary land-drainage systems completed, roads and tracks installed, etc.
2. Obtain fire marshal's approval of electrical installations, fire prevention devices, fire exits, etc.
3. Make prestartup arrangements after facilities are completed.
   a. Make final preparations for use of facilities.
      (1) Sign up for utilities.
      (2) Install office furniture, cafeteria, and welfare facility equipment.
      (3) Install communications equipment, including telephone.
      (4) Obtain necessary spare parts inventories for all equipment and machinery, etc.
   b. Make final inspection and sign off on facility and equipment.
      (1) Inspect all facilities.
      (2) Test all processing equipment and machinery.
      (3) Test all materials-handling equipment.

(4) Test all utilities, including the main power plant and the refrigeration system.

c. Select service contractors.
   (1) Refrigeration, heating, and electrical maintenance service.
   (2) Exterminator service.
   (3) Garbage-disposal service.
   (4) Medical service.

d. Procure insurance.
   (1) Fire and extended coverage insurance.
      (a) Buildings and equipment.
      (b) Livestock.
      (c) Meat inventories.
   (2) General liability insurance.
   (3) Theft insurance.
   (4) Vehicle insurance.

Budgeting

Once detailed estimates for capital expenditures in land, buildings, and equipment have been made from the preliminary layouts, the evaluators can then proceed to estimate the plant's annual investment cost and other expenses, including (1) costs of operating the plant, (2) probable costs of cattle procurement, (3) anticipated revenues from sales of various beef products and animal byproducts, and (4) costs associated with product distribution. The final step is to combine these items into a statement of overall projected net income. Exhibits A–D (appendix) are sample summary outlines for each of these budgeting categories and include the final statement of projected net income.

To save time, the evaluators may wish to consult published research for some detailed cost-estimating procedures and analytical formats to determine specific cost inputs (*11*, *23*, *29*, *31*, *44*, *62*, *118*). Direct consultations with equipment manufacturers, architects, and others will be needed to adjust and update these published data to fit any specific application. Guideline cost-analysis formats for boning and portion-controlled operations can also be obtained from published data (*10*, *18*, *22*, *63*). Other data are available to help calculate probable carcass dressing yields for varying sizes and grades of cattle as well as salable product yields for primal and fabricated meat cuts from varying weight ranges of carcass beef (*48*, *49*, *84*). Such information is essential for estimating merchandising margins and probable revenues from beef sales. Average variety meat yields (*82*) are needed to assign estimated sales values to these edible byproducts in addition to those anticipated revenues from skeletal meat sources.

Likewise, information on byproduct yields also must be known to predict profit potential. For example, blending packinghouse byproduct materials in a typical rendering operation results in a 50-percent moisture weight loss. In other words, tankage and tallow products amount to only about half the original raw-material weight. Approximate net yields amount to 25 pounds of dry meat and bonemeal tankage and about 25 pounds of refined tallow for every 100 pounds of fresh offal and bones. Beef blood, which is processed separately, has a moisture weight loss of about 83 percent. Typically, dry blood-meal solids yield between 13 and 15 pounds per 100 pounds of raw liquid blood depending on the extent of foreign matter and dilution caused by wash water runoff within the slaughter plant. Published information is available (*30*), but the prime source for such information is rendering-equipment manufacturers.

To increase the usefulness of the budgeting statement, the evaluators should analyze possible profits for a variety of operating alternatives that fit within the framework of the proposed plant's functions. For example, if primal breaking and boxing activities are being contemplated, profit expectations from further fabricating and portion-controlled programs should be examined, since they also would tend to increase the plant's overall profit potential. Likewise, those envisioning a boning operation in conjunction with a cow-slaughter plant should examine additional profit prospects from further meat-processing activities. None of the complementary operating alternatives available should be disregarded without at least analyzing their added costs and returns to determine whether income-generating potential exists and, if so, to what extent.

The budgeting analysis should also be aimed at identifying any operations that might restrict profits. Ways to eliminate or bypass such operations should be analyzed. For example, small to medium-sized plants might sell their offal and other inedibles in an unprocessed form rather than using available capital and labor for rendering operations. Those functions offering the poorest return on invested capital and labor inputs should, if possible, be weeded out.

To measure the project's capital-risk position, the evaluators should determine the break-even point for their projected income analysis. This can be done by estimating procurement, slaughtering, and processing costs as opposed to potential sales revenues at various levels of productivity (*23*). The object is to determine how many head of cattle must be slaughtered to cover the estimated costs of operating the proposed plant. The answer will provide a bench mark as to the minimum volume necessary to keep the plant from operating in the red.

Besides determining the break-even point for the firm, the evaluators might also consider gaging the profitability of overtime or second-shift operations. Final decisions on production levels, of course, must depend on a properly conducted analysis of local livestock availability to assure matching such projected production with probable raw-material resources.

If the proportion of owner equity is expected to be small, potential lenders will probably require an appraisal of the business venture's projected cash flow in addition to its projected income potential. Lending institutions and investment analysts want some evidence of how the cash flow of a proposed business might be planned to satisfactorily service current as well as long-term debts. The primary purpose is to determine just how much debt can be safely assumed with responsible provisions for repayment to assure lenders that cash deficits will not occur. Cash-flow analyses enable lenders to determine what probable cash income will be available throughout the year for a firm and whether it will be sufficient to satisfy all obligations on a month-to-month basis without causing the firm to default on any of its outstanding loans. Typically such cash-flow statements provide additional evidence on which to support a loan decision as well as provide a practical means of conveying the merit of a loan request to any correspondent lenders. Information on how to evaluate default risks associated with financing an investment can be obtained from several sources, including references cited here (*53, 74–76*), or the evaluators may wish to consult with an accountant before preparing an estimated cash-flow statement.

One of the inherent weaknesses of budget forecasting is that the analysis must be based on future price expectations and on anticipated operating costs. Since no one can be sure of future events, budgeting analyses are never exact, but they can and should offer a realistic view of prospective business opportunities. Typically the figures are never estimated to the penny but are nevertheless refined sufficiently to provide an accurate financial picture that will stand up under the scrutiny of others knowledgeable in the field.

Given today's immense demand for capital, the extent to which credit availability has tightened, and the constantly increasing criteria for loan approval, the likelihood of successful loan application based on an analysis filled with general statements and generalized documentation appears remote. Feasibility studies with their accompanying income projections and cash flows should be written in narrative form and should stress concrete facts as well as provide perceptive conclusions. In addition to appraising projected financial documents, lending institutions also consider such factors as current economic conditions in general and within an industry in particular, as well as technological progress in an industry and any other current circumstances that might affect the interpretation of feasibility. Therefore whenever possible, all such questions should be anticipated and provisions to answer them should be made and incorporated into the feasibility analysis.

It must also be remembered that packing-industry profit margins continue to remain meager, averaging less than 1 percent on sales. Therefore those that comtemplate only basic slaughtering and dressing operations are faced with the prospect of interpreting their budget forecast results within very restrictive limits. In other words, profit margins for such operations are so small that there is literally no room for any error in estimating. This, of course, severely limits the reliability of the projected income statement. Many analysts believe that the most practical way to determine the economic feasibilility of a strictly kill-and-chill operation is through the least cost-analysis approach. Here the soundness of the venture is based on an estimate of the plant's projected ability to kill cattle at costs as low as or lower than those of existing competitors. The calculations of feasibility are based on the estimated dollar-per-head killing cost. However, such a least cost analysis must be augmented by an analysis of assembly and distribution costs so that in-plant economies of operation are not offset by excessive costs for cattle procurement or beef distribution.

NEW INDUSTRY TRENDS

Carcass-Breaking and Boxing Operations

Beefpacking is a viable, dynamic industry in which internal change has become the rule rather than the exception. Industry leaders are establishing carcass-breaking and boxing operations alongside their slaughter operations. The successful market entry of this merchandising concept, called boxed beef, originated through the pioneering efforts of an Iowa firm (*47*) in 1967. Since then several other large-volume packers have established similar programs of their own.

Technologies involved in the boxed-beef program consist of breaking a beef carcass into 12 primal and subprimal units, which are then trimmed of excess fat and made into uniform saw-ready and knife-ready cuts. Uniformly trimmed and shaped these fabricated cuts are then placed in plastic barrier bags, which are vacuum packed to avoid shrinkage and discoloration of exposed muscle surfaces. The final step includes placing similar cuts into sturdy cartons that are code dated and forwarded to inventory storage. These fabricated cuts are sometimes referred to as thick cuts to differentiate them from thin or rough cuts, such as briskets, plates, flanks, skirts, and hanging tenderloins, which are removed along with kidneys and internal fat during the carcass-breaking operations.

The so-called thin or rough cuts are typically deboned and defatted for packaging and boxing along with the fabricated primal and subprimal cuts. Such packer-processing operations are all efficiently carried out using assembly-line techniques. And since the operations are performed at the source of supply, the resulting efficiencies from placing trimmed cuts in boxes for shipment are obvious.

Besides lowering labor costs by handling boxes instead of carcasses, the reduction in shipping weight per carcass is significant. For example, a cattle carcass initially weighing 650 pounds yields approximately 410 pounds of boxed cuts; about 140 pounds of trimmings and thin cuts; and 100 pounds of bones and fat, left behind at the plant, where they can be efficiently processed to yield high-quality byproducts that command high prices.

Additional monetary savings are derived from eliminating an average 4-percent in-transit shipping shrink and a national condemnation shipping loss average of 0.2 percent, attributed to hanging carcass beef becoming tainted, sour, putrid, or otherwise contaminated while in transit (*71*). Such conditions are typically caused by contaminated equipment, such as meat hooks, airborne bacteria, and contact with foreign matter resulting from "down-beef" situations, which refer to carcass quarters falling off meat hooks either while in transit or during warehousing operations.

Handling boxed beef also eliminates the need for overhead rail structures as well as meat hooks in reefer trailers and vans and reduces the tare weights of such transportation equipment and improves backhaul opportunities. The simplification of product form, reduction of actual product shipping weight, and unnecessary structural handling equipment mean a 40-percent space savings during transit and also at central distribution warehouses in urban areas (*33*). Boxed beef also permits direct distribution of different types of meat cuts to alternate markets and thereby helps conserve fuel energy resources. For example, instead of shipping carcass beef from Kansas to New York, where the carcasses might be broken to ship strip loins to Miami area hotels, boxed strip loins can be shipped directly from Kansas to Miami.

Although beef packers as a group have only recently begun to adopt the boxed-beef method of distribution, the concept is not actually new. Pork products have been prepared by packers and shipped in boxed form to the retailer for more than 50 years. Benefits attributed to the boxed-meat concept, which results in greater efficiency and resource utilization, are as follows:

- Improved meat-processing plant efficiency and labor productivity, resulting in lower per-unit handling and fabricating costs.
- Better control of overhead in-plant costs and lower distribution costs.
- More efficient meat-cutting procedures, with greater opportunity for standardization and control of uniform trim, cutting style, and quality.
- Improved markets and better utilization of byproducts.
- Vastly improved sanitation control, resulting in less spoilage and trim loss.
- Reduced product shrinkage in transit and increased storage life.
- Better utilization of materials-handling equipment, pallet-rack storage facilities, automated selecting systems, and code-dating techniques.
- Better distribution of meat cuts according to market preference and greater merchandising flexibility.
- Improved utilization of central warehouse space and retail backroom storage space and equipment.
- Reduction in meat cutter skills required at the retail level and therefore shorter training requirements and less cost.
- Reduction in retail time devoted to delivery receiving, handling, ordering, and inventorying.
- Improved retailer product rotation, better balanced inventories, and faster, more accurate inventory data control to avoid out-of-stock situations that reduce sales.

In a test cut-out and shipping experiment based on early 1973 prices (*113*), a leading beefpacker-processor determined that the boxed-beef concept produced a cost-reduction advantage of $36.33 per head compared to the traditional hanging beef carcass-distribution method. Based on conditions existing at the time, this means that if all fed cattle were marketed in this manner, consumers could realize an estimated savings of about 5 cents per pound on fresh beef purchases.

Although conflicting data (*17a*) at this time dispute these industry estimates of the savings impact of boxed beef, another study reexamining this issue is currently being conducted.

Nevertheless there is a definite trend toward packer-processed boxed beef and it appears to be accelerating. Packers constructing new, high-capacity slaughtering plants are providing additional facilities alongside to break, trim, bone, fabricate, and package large proportions of their total weekly kill.

Industry Changes Translate Into New Rural Job Opportunities

Besides reducing beef-marketing costs, such forward packer integration into carcass-breaking and boxing operations can be expected to significantly affect potential employment opportunities in rural communities where these packers are locating or are already located. Even communities that have enough existing slaughter-plant capacity can benefit by this forward packer-integration movement, since such additional processing activities require increased manpower.

For example, if a carcass-breaking and boxing operation were established in conjunction with an existing cattle-slaughter plant killing 120 head per hour, such beef-processing activities could generate additional employment for as many as 210 persons when direct as well as indirect labor requirements, such as cleanup crews, are considered. This estimate is based on a direct labor and supervisory personnel productivity level of 385 pounds per man-hour during 7½ hours of productive time per day that includes trimming and boning activities. It translates into 203 production-line and supervisory jobs when a day's production averages 900 head at an average 650 pounds per carcass. The remaining seven employee positions would satisfy indirect labor requirements. Even if only 60 percent of the plant's daily kill were processed and boxed, there would be additional job opportunities for 126 people beyond those already employed in the plant's kill-and-chill operations.

Besides providing employment for local residents, this trend might encourage skilled industry personnel now living in urban areas to relocate to well-paying jobs in a rural environment. Such an increase in steady employment opportunities could help stabilize current population levels in certain rural areas or even encourage further growth. New residents need homes, community services, and other necessities. Using an employment multiplier of 2.82 for agricultural processing industries, the impact of 126 new beefpacking plant jobs could mean additional indirect job opportunities for another 355 persons.

Constructing and equipping such processing facilities and training a competent staff to operate them are expensive. Such additional packing-plant facilities represent a major financial commitment over and above the costs necessary to initially construct, equip, and capitalize a kill-and-chill operation. To establish facilities to produce boxed beef for a 20-head-per-hour slaughter plant at 1976 prices, packers would be required to invest another $210,000 in buildings and equipment alone. A minimum of $525,000 would be needed for a 60-head-per-hour plant and $1 million for a 120-head-per-hour plant. Upward adjustments in welfare and cafeteria facilities would also be needed to accommodate the plant's increased labor force. Greater boiler plant capacity and refrigeration needs would be required as well as other plant facility aspects, such as office space to handle the increased paperwork load. Also, additional operating capital would be needed to successfully finance a beef carcass-breaking and boxing operation.

Portion-Controlled and Precooked Beef Manufacturing

Other far-reaching events are also shaping and transforming future developments within the beefpacking industry. Leading industry innovators are now adding yet other types of meat-processing functions to their automated production lines. They are including facilities at the packer-processor level to manufacture portion-controlled and precooked convenience beef products. Meat in these forms is generally sold in bulk lots to the hotel, restaurant, and institutional (HRI) trade. Since an estimated 20 percent of the quantity of meat, poultry, and fish is consumed away from home (*40*), restaurants and institutions represent a very promising, major market outlet for these innovative packers.

Portion-controlled beef basically refers to meat that has been fabricated into uniform portions of equal weight suitable for individual servings. However, the HRI trade also uses solid meats, such as webbed oven-ready roasts and cube chunks for stews, as well as the familiar portion-molded products derived from flaking, chopping, and grinding techniques. Other familiar portioned items include both solid boneless and bone-in meats like fillets, strip steaks, and T-bones. Also, mechanical tenderizing devices with small sharp blades automatically sever tendons and soften muscle tissue without altering product appearance in the manufacture of portion-controlled sandwich steaks and other items.

Such processing activities increase packer profitability substantially. From a traditional after-tax profit level of 1 percent or less, industry sources suggest that forward integration by packers into carcass-breaking and boxing operations alone makes possible an increase in profits after taxes by an additional percentage point for a total of 2 percent on gross sales. Further fabricating activities, such as portion-controlled manufacturing, make possible an increase in after-tax profit of as much as 4 percent on the sales dollar. Opportunities to improve corporate profitability are largely being made possible by simply providing the industry with a practical, more efficient method of marketing beef to the consuming public and making better use of existing rural resources. Although the ultimate objectives of packers diversifying their functions are to widen profit margins and gain greater market latitude, such intensified packer-processing activities also greatly accelerate rural job opportunities as well.

Determination of job potentials stimulated by activities such as portion-controlled manufacturing depend on several variables. Will the beef be received in the plant's manufacturing area in whole carcass form or in trimmed primal and subprimal cuts from carcass-breaking operations located in another part of the plant? What will the final product mix consist of in terms of large, thick cuts versus sliced and molded products? What levels of handling and packaging automation will be used? Will products be packaged in bulk rather than individual consumer-size units? Generally speaking, when primals are reduced to HRI cuts and portion-controlled items and most of the day's production is bulk packaged, direct labor and supervisory personnel productivity per manhour can average 180 pounds or slightly better. Other physical product circumstances can sharply curtail this productivity estimate of job performance, since beef carcasses are not uniform in size and tend to be difficult to work up even on production lines.

Manufacturing, curing, and packaging corned beef, as well as preparing precooked convenience food specialties like skewered beef shish kabobs, beef snacks, and entrees, offer further employment-generating opportunities and also expanded profit incentives. But these possibilities are difficult to estimate without consulting specific equipment manufacturer's representatives. Such equipment might include mechanical cooked patty-processing systems with specialized conveyors, battering and breading machines, continuous broilers and searing mechanisms, fryers, and superchilled air tunnels.

Hourly productive capacities, maintenance needs, and recommended manning stations all are involved in coordinating such machinery with other in-plant functions and in determining ultimate total labor personnel needs. Moreover, such broad possibilities for packer diversification of product lines emphasize the need for new plant layouts to be designed so that any fabricating and processing activities like these could be integrated into the plant's operation in the future without sacrificing the efficient product flow and overall productivity originally built into the slaughtering operation. Marketing channels for portion-sized precooked and fully cooked "heat and eat" meats include food-service operators catering to airlines, hospitals, fast-food restaurants, vendors, specialized 24-hour convenience markets, and others.

Potentials of Manufacturing Consumer Packaged Frozen Meats

Additional future developments within the industry are also possible. Technologies to produce attractive, high-quality, frozen, retail beef cuts are now a reality and readily available to the industry. With cryogenic freezing techniques using liquid nitrogen and superior packaging films, packer-processors have the tools to enable them to further reduce the costs of merchandising beef by manufacturing case-ready consumer packages at the source of raw-material supplies. Such fabricating and processing activities would further enhance those advantages and savings cited for breaking carcass beef at point of animal slaughter and would also provide many additional advantages as well, such as significantly increasing the storage life of a commodity that is highly perishable in its natural state. If the product were no longer highly perishable, distress selling could be minimized or eliminated, and this would help stabilize market prices. Indeed, packer preparation of prepackaged retail cuts in a stabilized frozen form may provide the food merchandising industry with the most efficient method attainable for distributing and marketing beef to the consuming public.

However, the success of such a program will probably come about through an evolutionary rather than a revolutionary process despite its obvious built-in efficiencies. Several obstacles still plague the potential development of mass-marketing frozen retail meat. Some stem directly from mishandling and temperature abuses. Adequate temperature control of the product, both in transit from source of supply and during the storage cycle at metropolitan distribution centers, appears to be severely lacking in many instances. Careless initial handling by retail clerks, coupled with overstacking of display cases in anticipation of peak-hour store sales, and temperature fluctuations in these retail display freezers cause product discoloration and frost buildup. These problems are particularly critical to frozen meat merchandising because of product visibility.

Many open freezer cases go through three defrosting cycles per day, causing temperature variations from −10° to as high as 45° F (*114*). Display lighting also contributes to frozen meat discoloration. But regardless of where or how these abuses occur, their ultimate results are lost sales opportunities, shorter shelf life, poorer quality, and a higher percentage of returned product to the distributor.

Nevertheless these are mere technical problems and can be overcome. There are no significant difficulties associated with off-color or microbial spoilage causing off-odor and off-flavor if frozen products are handled under proper refrigerated conditions. If rigid controls for maintaining constant subzero temperatures throughout the beef-marketing system are adopted and heat output from display lights is minimized, these problems can be solved.

The major problem confronting the development of mass-merchandising frozen retail meat appears to be consumer resistance. Regardless of product attractiveness and condition, consumers remain prone to purchase the fresh product if readily available (*50*). Yet they will repeatedly purchase the fresh product on sale and take it home to freeze it under the worst possible conditions.

For example, most combination refrigerator-freezers are actually designed to maintain the temperature of an already frozen product and not to bring down the internal temperature of an unfrozen product, although such freezer compartments will ultimately accomplish the task. Freezing 10 pounds of fresh hamburger in a typical 3.5-cubic foot unit filled with other products will take approximately 12 to 16 hours. Many freezer units still in service today are not frost-free, and therefore with ice buildup the time lapse required to freeze such fresh products can be considerably longer. The result of this slow freezing process is a dark, off-color product and sometimes off-odors as well depending on the condition of the fresh hamburger meat prior to freezing. Also, slow freezing of solid meats such as steaks causes large ice crystals to form within the muscle tissue and results in ruptured cell structure and severe weeping when the product is thawed. This reduces both product weight and nutrient content.

Obviously the industry must mount a massive educational and promotional program to overcome such consumer mistrust and unfamiliarity about commercially frozen meat and the benefits derived from cryogenic freezing technology if consumers are ever to accept frozen retail meat. With liquid nitrogen, meat freezes so rapidly that large damaging ice crystals do not form. The color of the meat under protective film shows little evidence of having been frozen. Fortunately packers processing and merchandising frozen portion-controlled meats for restaurants and institutions are not affected by such strong consumer resistance, because the product is cooked before being served to the public.

Apart from these problems confronting the merchandising of consumer packaged frozen meat, other disadvantages cited (*77*) include (1) union tradition and contract difficulties, (2) cost of equipment changeover, and (3) retailer skepticism.

Competitive Forces Outside the Packing Industry

Although the achievement of these beefpacking industry goals may seem extremely optimistic, they nevertheless are attainable with proper consumer education, adequate industry motivation, and available financing at reasonable cost. Packer forward integration through such diversification activities as prepackaging frozen retail meats will reduce the costs of merchandising beef and ultimately help stabilize prices. However, before the beefpacking industry can attempt to achieve these goals, it must first consider the extent and effect of competitive forces from other segments of the food industry.

Potential Competition From Food Retailers

Corporate chains, independents, volunteers, cooperatives, and other food retailers have also seen the merits in merchandising beef through the market ready-boxed meat program, since their backroom meat-cutting operations at the store level can be greatly improved through efficiencies associated with the program. Consequently, many have already constructed their own carcass-breaking and boxing facilities since the late 1960's at distribution centers in large metropolitan areas.

A survey conducted by the National Association of Food Chains in early 1973 found that more than half the fresh beef shipped to supermarkets was centrally prefabricated (*65*). However, a closer examination of the statistics reveals that of the 51 percent arriving at the retail store in subprimal form during 1972 only 31 percent was vacuum packed. The remaining 20 percent was soft film wrapped but probably not necessarily placed in boxes or wire baskets. It should be remembered that chains have traditionally received much of their fresh beef deliveries at the retail store level in primal and subprimal cuts. This is not something entirely new. Such deliveries were and still are made on treed meat hooks with either soft film or brown paper overwraps. And, to some extent this type of delivery is undoubtedly incorporated into the survey's statistical data.

The survey, however, does show that retailers expected about two-thirds of their fresh meat shipments to arrive vacuum packed at store level by 1977. Unfortunately no information was available from the survey regarding the extent to which these anticipated increases would originate from centralized chain carcass-breaking facilities as opposed to shipments of boxed meat fabricated at packer facilities. But the survey did indicate that the overall trend toward centralized breaking of beef carcasses into subprimal cuts and vacuum packaging is accelerating rapidly.

A few innovative high-volume chainstore operators have carried this centralization process a step further by establishing meat service centers, where fresh beef and other red meats are retail cut, consumer packaged, and priced prior to store delivery. This transition has been brought about largely as a result of management's efforts to bolster its meat department profits in the face of escalating labor wage rates and other operating expenses. But such transitionary moves may ultimately prove to be only a stopgap measure. As long as such central retail meat-cutting and packaging operations handle strictly fresh products, then these high-volume operators with large meat-case displays in scattered metropolitan retail stores will continuously face rewrap and discount sales problems, since returning leakers and off-color merchandise to the central facility is often uneconomical. Distance usually becomes the overriding consideration in making policy decisions on returns and on markdowns for distressed products.

Retailers considering central meat cutting must also face difficult capital investment decisions. Current urban building costs are acute and land is both scarce and high priced. Utilities and taxes are also high in comparison with those in rural surroundings. Supermarket management must consider alternative investment priorities as well. An investment in automated checkout equipment or automated distribution warehousing might improve potential net profits more than an investment in central retail meat-cutting facilities. Retailers have been branching out into merchandising ever-increasing numbers of nonfood items, and these other alternative investment opportunities could permit them as retailers to concentrate on improving their merchandising activities.

Nevertheless proponents of the chainstore precutting and prepackaging concept can point to one highly successful low-volume midwestern retailer and several European chainstore firms that have been operating for over a decade. And, of course, retailers too could go into mass-prepackaging frozen retail meats, but packers would have a definite competitive edge in such an undertaking.

Potential Competition From Synthetics

Besides thoroughly analyzing the impact that direct competition from food retailers would have on potential opportunities for expanding their beef-processing activities, packers would be prudent to also consider the possible long-range implications that improved, low-cost synthetic meat substitutes might have on the future outlook of their industry. Owing to the growing world shortage of animal proteins, which becomes more severe each year, food scientists have intensified their search for new and better ways to convert relatively cheap, high-yielding sources of vegetable protein into acceptable meat substitutes. If such efforts eventually prove successful in the years ahead, they could substantially alter the market outlook for beef as well as other red meats.

Strictly from an efficiency standpoint, livestock production is a very poor method of converting grain into animal proteins for human consumption. Substantially better results can be achieved by extracting proteins directly from plant sources. For example, after a 1,000-pound live steer is slaughtered, the animal's carcass typically will weigh about 615 pounds and about 432 pounds when cut, trimmed, and packaged into retail consumer cuts. However, cooking loss from shrinkage will reduce the cooked beef from these consumer raw cuts down to about 313 pounds, and further table losses from trimming away additional fat, gristle, and bone will yield, on an average, only 213 pounds of cooked, lean meat.

Assuming an average protein content of 29.6 percent after bone, gristle, and excess fat are removed from the cooked meat, a 1,000-pound live steer will yield about 63 pounds of animal protein for human consumption from the animal's skeletal muscle tissue.

Some proponents of vegetable proteins point out that about 6.5 pounds of feed grains are required to produce each pound of live-weight gain for feedlot cattle. They then state that this means a 1,000-pound live steer represents, or is equivalent to, 6,500 pounds of high-ration feed, which normally contains about 11 percent of crude protein. This total sum of 3.25 tons of concentrates therefore would yield about 715 pounds of crude protein. Consequently, the conversion-efficiency ratio for turning feed into beef is about 14.2 to 1. In other words, cattlemen are feeding and fattening animals that have a protein conversion-efficiency rating of about 7 percent.

Cattlemen, however, would quickly point out that beef calves weigh 80 pounds at birth and forage on grasses while gaining their first 420 pounds and often remain on such vegetation, which humans cannot consume, until attaining weights of 650 to 700 pounds. Moreover, vast quantities of agricultural acreage unsuitable as cropland can be grazed by cattle and calves as grassland pastures and woodlands. Residue crop wastes, ensilages, and hay also are fed to cattle. Furthermore, at current technology levels about 30 percent of the crude protein content in feedlot rations cannot be assimilated by humans. Adjustments must also be made to account for the animal protein content of variety meats, such as livers, hearts, kidneys, beef tongues, cheek meat, tripe, and oxtails. Likewise, consider that recycled animal proteins contained in inedible byproducts, such as blood, bones, and viscera, are converted into feed and fed back to other animals. Hides, gelatin, and glue stocks also contain protein. But above all, beef is an extremely palatable food that provides quality protein high in all 10 essential amino acids.

Nevertheless beef remains an expensive commodity and a costly source of proteins for human consumption. At an average retail price of $1.39 per pound for all cuts of choice-grade beef, the animal protein that consumers obtain actually costs them $9.53 per pound. On the other hand, at an average price of $1.03 per pound for canned ready-to-serve, textured meat analogs with an 18-percent protein content, consumers pay $5.72 per pound for vegetable protein, and this price could be reduced substantially.

Current demand for such meat analogs is small, primarily because of limited consumer appeal, and therefore production costs are usually very high. These analogs appear to be aimed at satisfying a narrow market made up of affluent vegetarians. Should the eating-quality characteristics of these engineered food protein products be greatly improved, the demand could be broadened and thus permit mass marketing. This, in turn, would reduce unit processing costs substantially and help bring down the price consumers would have to pay for their vegetable protein in this form.

In addition to meat analogs, which resemble specific meat items in texture, color, and flavor, other forms of vegetable protein are also prepared as partial substitutes for meat in processed items like beef patties, chili, and casserole dishes. It is this form of vegetable protein that holds the most promise for reducing the cost of protein for consumers now and in the immediate future.

A prepared vegetable protein-ground beef blend was introduced at chain meat counters in March 1973, and survey data (*87*) indicate that this blend captured 26 percent of ground beef sales during a 30-week trial in these stores. Apparently the lower price was the major reason for its success. Sales of the blend generally decreased, however, when the price differential between the blend and 100-percent beef hamburger was less than 10 cents per pound. Another study conducted at Cornell University (*28*) indicates that formulated vegetable proteins used as meat extenders and analogs may account for 10 percent of all domestic meat consumption by 1985.

As engineered protein food products, vegetable proteins can offer several functional advantages over natural meat products. For example, meat extenders and substitutes lack animal fat, which has been cited by medical authorities as a possible health hazard in the diet. Such alleged medical claims, however, remain unsubstantiated and actually attack animal fat and not lean beef. Synthetics also provide consistently uniform quality with controlled nutritional composition, which offers both economies and convenience to the food processor. And they are stable products, possessing long storage shelf life without need of refrigeration.

The long-range implications of competition from vegetable protein substitutes are obvious. Although some packers still consider red meats to be immune to market penetration from such substitutes, a brief reflection of the facts should quickly alter this impression. However, without attempting to play down the importance of these long-range implications and their potential repercussions, which could be felt throughout the livestock-meat industry, many see the packer's immediate challenge as an urgent need for increasing efficiencies and doing a better job of marketing in order to lower the current costs of beef to the consuming public. Though Americans still consider beef as a staple in their diet, many in other nations of the world regard it as a luxury. If beefpackers are to continue to expand production and provide steady employment in the face of rising consumer prices, more efficient methods of producing and marketing beef will have to be adopted to help prevent the public from reducing their beef consumption requirements. Such measures will require a strong, united effort on the part of all sectors of the livestock-meat industry, as well as the retail merchandising and food service segments of the food industry.

More dollars are spent for beef than for any other agricultural commodity produced in the United States. Cattle and calf sales account for about one-fifth of all cash receipts from farm marketings. Consequently, the fate of many direct and indirect industry-related jobs, as well as many potential employment opportunities in the future, will depend on the planning decisions now being made by managers of the beefpacking industry.

Packer forward integration through such activities as manufacturing retail packaged frozen meat would reduce the costs of merchandising beef and help stabilize market prices by establishing inventories and minimizing or eliminating distress sales commonly associated with the fresh product. Also, farsighted managers will likely tend to regard new products made in part by vegetable protein as an opportunity rather than a threat. By planning now to participate in the manufacture of extended meat products and such items as precooked semianalog blends, packers have an additional opportunity to increase their processing activities and market diversification potential while at the same time helping to lower the costs of protein to consumers.

Probably the ultimate number of future rural job opportunities directly and indirectly related to the beefpacking industry will depend on how successful packers are in obtaining these goals.

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APPENDIX

EXHIBIT A.—*Sample outline for estimating annual in-plant operating costs of a proposed beefpacking plant*

Item	*Annual operating costs for plant with ______ head-per-hour kill capacity (dollars)*[1]
Wages and salaries:	
Kill-floor personnel (union)	
Supporting operations personnel (union)	
Office personnel	
Management	
Employee benefits:	
Pension fund program	
Social Security taxes[2]	
Insurance and hospitalization	
Vacation, holiday, and sick leave	
Total labor and management costs	
Investments in land, buildings, and equipment:	
Interest charges	
Depreciation charges	
Insurance	
Property and equipment taxes	
Total investment costs	
Utilities:	
Water	
Electricity	
Fuel (oil or gas)	
Sewage disposal[3]	
Total utility costs	
All other costs:	
Interest charges on operating capital	
Federal or State meat inspection service (overtime only)	
Federal meat-grading service	
4-D condemnations and animal tissue losses[4]	
Maintenance and repairs[5]	

See footnotes at end of exhibit.

EXHIBIT A.—*Sample outline for estimating annual in-plant operating costs of a proposed beefpacking plant*—Continued

Item	*Annual operating costs for plant with head-per-hour kill capacity (dollars)*[1]
All other costs—Continued	
Killing supplies[6]	
Packaging supplies and containers	
Office supplies[7]	
Communications	
Taxes and licenses[8]	
Audit and legal fees	
Miscellaneous expenses[9]	
Total other costs	
Total operating costs	

[1] Estimates should be based on data that assume the plant will be operated at 100 percent of its rated line speed on an annual basis.
[2] Including unemployment insurance and workmen's compensation.
[3] Including pretreatment expenses.
[4] Cash losses from 4–D (dead, dying, diseased, and disabled) animal condemnations, animal bruises, cattle grubs, etc., removed by inspectors.
[5] For buildings and equipment, including refrigeration maintenance charges.
[6] Including initial costs for employee gowns and aprons, safety hats, and other personnel equipment; gown and uniform cleaning costs; shrouds and shroud laundry costs; neck skewers and shroud pins; and facility cleaning equipment and janitor supplies.
[7] Including service to office equipment, company-labeled cash receipt forms, and similar paper supply needs.
[8] Including taxes other than on property and also various community, city, and State licenses.
[9] Including banking charges, public relations expenses, medical service, trash-disposal service, exterminator service, landscaping and grounds maintenance service, and animal feeds.

EXHIBIT B.—*Sample outline for estimating annual livestock procurement costs of a proposed beefpacking plant*

Slaughter cattle	Total weight of cattle purchased[1]	Average purchasing price[2]	Initial cost of cattle	Purchasing, handling, and transportation charges[3]	Total livestock procurement costs[4]
	Lb	*Dollars per cwt*	*Dollars*	*Dollars*	*Dollars*
Steers (lb):					
Prime:					
900–1,100					
1,100–1,300					

See footnotes at end of exhibit.

EXHIBIT B.—*Sample outline for estimating annual livestock procurement costs of a proposed beefpacking plant*—Continued

Slaughter cattle	Total weight of cattle purchased[1]	Average purchasing price[2]	Initial cost of cattle	Purchasing, handling, and transportation charges[3]	Total livestock procurement costs[4]
	Lb	*Dollars per cwt*	*Dollars*	*Dollars*	*Dollars*
Steers (lb)—Continued					
Choice:					
800–900					
900–1,100					
1,100–1,300					
Good:					
700–900					
900–1,100					
1,100–1,300					
Standard (all weights)					
Heifers (lb):					
Prime:					
700–900					
900–1,100					
Choice:					
700–900					
900–1,100					
Good:					
500–700					
700–900					
Standard (all weights)					
Cows (all weights):					
Commercial					
Utility					
Cutter					
Canner					
Bulls (all weights, yearlings excluded):					
Good					
Commercial					
Utility					
Cutter					
Total					

[1] Convert the number of head of cattle to be purchased into pounds by using the median weight for each type and weight class. Then depending on marketing practices found in the trade area analyzed, adjust cattle weights to reflect typical estimated or actual shrinkage. The estimated grade, weight, and sex of live cattle selected should reflect typical dispersion in the trade area.

[2] Based on an assessment of current and projected price quotations for live cattle of the type to be slaughtered as well as common marketing practices in the local trade area. Apart from local public market price quotations, current livestock price data can be obtained from the USDA's "Livestock, Meat, and Wool Market News Weekly" summary

series published by the Livestock Division, Agricultural Marketing Service, USDA, Washington, D.C. The "National Provisioner Yellow Sheet" is another source of current live cattle quotations. See the USDA's "Livestock and Meat Situation" series published by the Economic and Statistical Analysis Division, Economic Research Service, for cattle price forecasts.

[3] Based on costs for (1) buyer salaries, benefits, and commissions and also operating costs of vehicles; (2) auction or stockyard charges, if any; (3) unless the seller is to pay for transportation, determine truck drivers' salaries and benefits and truck operating costs or transportation charges if hauled by common or contract carriers; and (4) insurance on livestock in transit. Probable procurement costs should reflect conditions in the trade area analyzed, with assembly costs based on anticipated travel times and distances, number of cattle per haul, and routing schedules.

[4] In the Packers and Stockyards Act, paragraph 201.43–B of the regulations states that "each packer, market agency, or dealer purchasing livestock shall, before the close of the next business day following the purchase of livestock and the determination of the amount of the purchase price, transmit or deliver to the seller, or his duly authorized agent, the full amount of the purchase price. . . ." This means that sufficient cash-on-hand must be available to pay for a normal 2-day supply of purchased cattle, assuming that a 2-day inventory of cattle will be in the plant's corrals on a continuous basis. The working capital needed therefore would amount to 2/252 (2 days' purchases of the 252 working days that cattle are slaughtered annually) or 0.8 percent of the total amount spent annually to buy cattle. The interest cost on this operating capital coupled with aggregate annual procurement expenditures, found at the bottom of the last column, would then be incorporated into the projected expenses for livestock procurement costs to appear in exhibit D.

EXHIBIT C.—*Sample outline for estimating annual gross income from meat and animal byproduct sales and annual costs of sales and distribution for a proposed beefpacking plant*

Beefpacking-plant products (trailer or carlot basis f.o.b.)	Total quantity of merchandise sold [1]	Average price received [2]	Total gross income from sales	Total sales and distribution costs [3]
	Lb	*Cents per lb*	*Dollars*	*Dollars*
Wholesale dressed beef:				
Steers (lb):				
Prime:				
600–700				
700–800				
Choice:				
500–600				
600–700				
700–800				
Good:				
400–500				
500–600				
600–700				
700–800				
Standard (all weights)				
Heifers (lb):				
Prime:				
400–500				
500–600				
600–700				

See footnotes at end of exhibit.

EXHIBIT C.—*Sample outline for estimating annual gross income from meat and animal byproduct sales and annual costs of sales and distribution for a proposed beefpacking plant*—Continued

Beefpacking-plant products (trailer or carlot basis f.o.b.)	Total quantity of merchandise sold [1]	Average price received [2]	Total gross income from sales	Total sales and distribution costs [3]
Wholesale dressed beef—Continued	*Lb*	*Cents per lb*	*Dollars*	*Dollars*
Heifers (lb)—Continued				
Choice:				
400–500				
500–600				
600–700				
Good:				
400–500				
500–600				
600–700				
Standard (all weights)				
Boning cattle:				
Cows (all weights):				
Commercial				
Utility				
Canner and cutter				
Bulls (all weights):				
Utility				
Cutter				
Fresh boneless beef:				
Lean trimmings:				
90 percent				
50 percent				
Commercial beef tenderloins:				
Cows—3 lb and up				
Bulls—5 lb and up				
Primal beef cuts—choice (lb):				
Straight hinds, 120–190				
Straight rounds, 65–95				
Loins (trimmed), 50–70				
Straight fores, 135–210				
Arm backs, 110–150				
Arm chucks, 80–130				
Ribs, 24–32				
Briskets				
Plates (navels)				
Other				
Fabricated beef cuts:				
Choice (lb):				
Rounds				
Sirloin tips				
Loin ends				
Short loins				

See footnotes at end of exhibit.

EXHIBIT C.—*Sample outline for estimating annual gross income from meat and animal byproduct sales and animal costs of sales and distribution for a proposed beefpacking plant*—Continued

Beefpacking-plant products (trailer or carlot basis f.o.b.)	Total quantity of merchandise sold[1]	Average price received[2]	Total gross income from sales	Total sales and distribution costs[3]
	Lb	*Cents per lb*	*Dollars*	*Dollars*
Fabricated beef cuts—Continued				
Choice (lb)—Continued				
Ribs				
Blade chucks				
Armbone chucks				
Gooseneck rounds				
Inside rounds				
Strip loins				
Boneless strips				
Tenderloins				
Boneless briskets				
Other processed meats and portion-control products[4]				
Subtotal				
Edible byproducts:				
Variety meats:				
Beef tongues				
Udders				
Cheek meat				
Head meat				
Oxtails				
Hearts				
Kidneys				
Lips, scalded				
Livers				
Lungs				
Melts				
Tripe, scalded				
Sweetbreads				
Edible tallow (all grades – for salad oils, shortenings, deep fat frying, and food additives)				
Subtotal				
Inedible byproducts:				
Hides, cured:				
Heavy native steer				
Light native steer				
Extra light native steer				

See footnotes at end of exhibit.

EXHIBIT C.—*Sample outline for estimating annual gross income from meat and animal byproduct sales and annual costs of sales and distribution for a proposed beefpacking plant*—Continued

Beefpacking-plant products (trailer or carlot basis f.o.b.)	Total quantity of merchandise sold[1]	Average price received[2]	Total gross income from sales	Total sales and distribution costs[3]
	Lb	*Cents per lb*	*Dollars*	*Dollars*
Inedible byproducts—Continued				
Hides, cured—Continued				
Colorado branded				
Butt branded				
Heavy native cow				
Light native cow				
Branded cow				
Native bulls				
Kipskins				
Hides, green (all types)				
Inedible tallows:				
Fancy, high titer, bleachable				
Prime				
Feed grade				
Fleshing oil				
Inedible greases:				
Yellow				
House				
Packinghouse feeds:				
Meat and bonemeal, 50 percent, bulk				
Meat meal tankage, 60 percent, bulk				
Steamed bonemeal, 60 percent, bags				
Dried blood meal, bags				
Gelatin and glue stocks:				
Bone stock (gelatin), ton				
Jaws, feet (nongelatin), ton				
Rennets				
Trim bone, ton				
Pharmaceuticals (liver, pancreas, parathyroid, pineal, pituitary, spleens, suprarenal, thymus, fetal blood, surgical gut, ox bile, and gallstones)				
Subtotal				
Total				

See footnotes at end of exhibit.

[1] Convert the total weight of live cattle to be purchased into the total weight of beef and byproducts to be sold based on (1) the type and weight of cattle to be purchased, using the median weight for each type and weight class after the shrink adjustment; (2) appropriate dressing and product yields for these cattle; and (3) the anticipated methods to be used to merchandise the products, e.g., X percent to be sold as carcass beef, Y percent sold as fabricated, boxed primals, Z percent sold as portion controlled items, etc.

[2] Based on an assessment of current and projected wholesale price quotations for beef and byproducts of a quality predetermined by the type of cattle to be slaughtered. Current wholesale price data can be obtained from the USDA's "Livestock, Meat, and Wool Market News Weekly" summary series published by the Livestock Division, Agricultural Marketing Service, USDA, Washington, D.C. The "National Provisioner Yellow Sheet" is another source of current wholesale beef and byproduct price quotations. See the USDA's "Livestock and Meat Situation" series published by the Economic and Statistical Analysis Division, Economic Research Service, for wholesale beef and byproduct price forecasts. "Outlook" price information is also available from colleges of agriculture and livestock-producer marketing groups.

[3] Based on costs for (1) salesmen's salaries, benefits, commissions, traveling expenses, and operating costs of vehicles, if the firm is to have its own sales force; (2) advertising, if any; (3) brokerage fees and other commissions, if any; (4) cold storage charges, if any; (5) truck drivers' salaries and benefits and truck-operating costs, or transportation charges, if meat and byproducts are to be hauled by common or contract carriers; (6) insurance on meat and byproducts in transit; (7) any losses from damaged merchandise not reimbursed by insurance claims; (8) anticipated losses from bad debt accounts.

The estimated operating capital requirements for a typical beef-distribution cycle after slaughter would amount to 19/252 or 7.5 percent of the plant's annual sales revenues. This is based on the assumption that the plant would need cash on hand to cover (1) a minimum 2-day inventory kill in its chill- and sales-holding coolers; (2) a 3-day kill volume in transit, based on a 3-day delivery cycle; and (3) a minimum 14-day settlement period for accounts receivable after the merchandise is received and inspected by the purchaser. A specific beef-distribution cycle, of course, would depend on the proposed plant's location in relation to its selected market distribution areas, as well as the typical length of the billing cycle as affected by the accounts receivable delinquency rate found at the time and place of the feasibility analysis. The interest charge on this operating capital coupled with aggregate annual sales and distribution expenditures, found at the bottom of the last column, would then be incorporated into the projected expenses for sales and distribution cost to appear in exhibit D.

[4] Enumerating the various types and consumer package sizes of processed meat items that packers could manufacture as complementary plant functions in concert with their normal operations would require a lengthy list. Manufacturing such standard meat items as bologna, frankfurters, beef sausage, and the various luncheon loaves like pepper loaf and pickle and pimento loaf is an obvious possibility for those planning a cow-slaughter operation. For those planning to slaughter fed cattle, further complementary plant operations could include the manufacture of portion-controlled items, such as beef patties, minute cube steaks, molded steaks, and stew-beef cubes to mention just a few. Manufacturing sliced, smoked beef bacon, smoked beef tongues, pastrami, and pickled corned beef are other possibilities. Some packers manufacture precooked convenience foods, such as snack items, entrees, and complete dinners. Even pet-food manufacturing offers increased profit opportunities.

Related information on current and projected prices for items such as those described here can be obtained from several sources, including the "National Provisioner's Hotel, Restaurant, Institutional Meat Service Report."

EXHIBIT D.—*Sample outline for projecting annual estimated net income of a proposed beefpacking plant*

Item	*Annual amount (dollars)*
Gross income from sales:	
Meat products	
Edible byproducts	
Inedible byproducts	
Total	
Expenses:	
Livestock procurement	
Packing-plant operation	
Sales and distribution	
Startup [1]	
Total	
Net income:	
Earnings before State and Federal taxes	
Total income tax	
Total	

[1] To be amortized over first 5 years of plant operations. Initial startup costs for a beefpacking plant include the following: (1) Expenses for recruiting management, cattle buyers, and meat salesmen; (2) expenses for selecting, hiring, and training the labor force and office personnel; (3) salaries for these personnel before full-scale plant operations are underway; (4) expenses incurred by buyers lining up livestock-producer accounts; (5) expenses incurred by salesmen lining up meat-product and animal-byproduct outlet accounts; (6) security deposits for utilities and telephone installations; (7) costs of initial promotional activities, including ground-breaking ceremonies, open house, and preopening advertising campaigns; and (8) costs of initial inventory supplies, including spare parts for equipment and machinery, packaging supplies and containers, office supplies, employee gowns and aprons, safety hats and other personnel equipment, laundry supplies, shrouds, shroud pins, neck skewers, and janitor supplies.

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